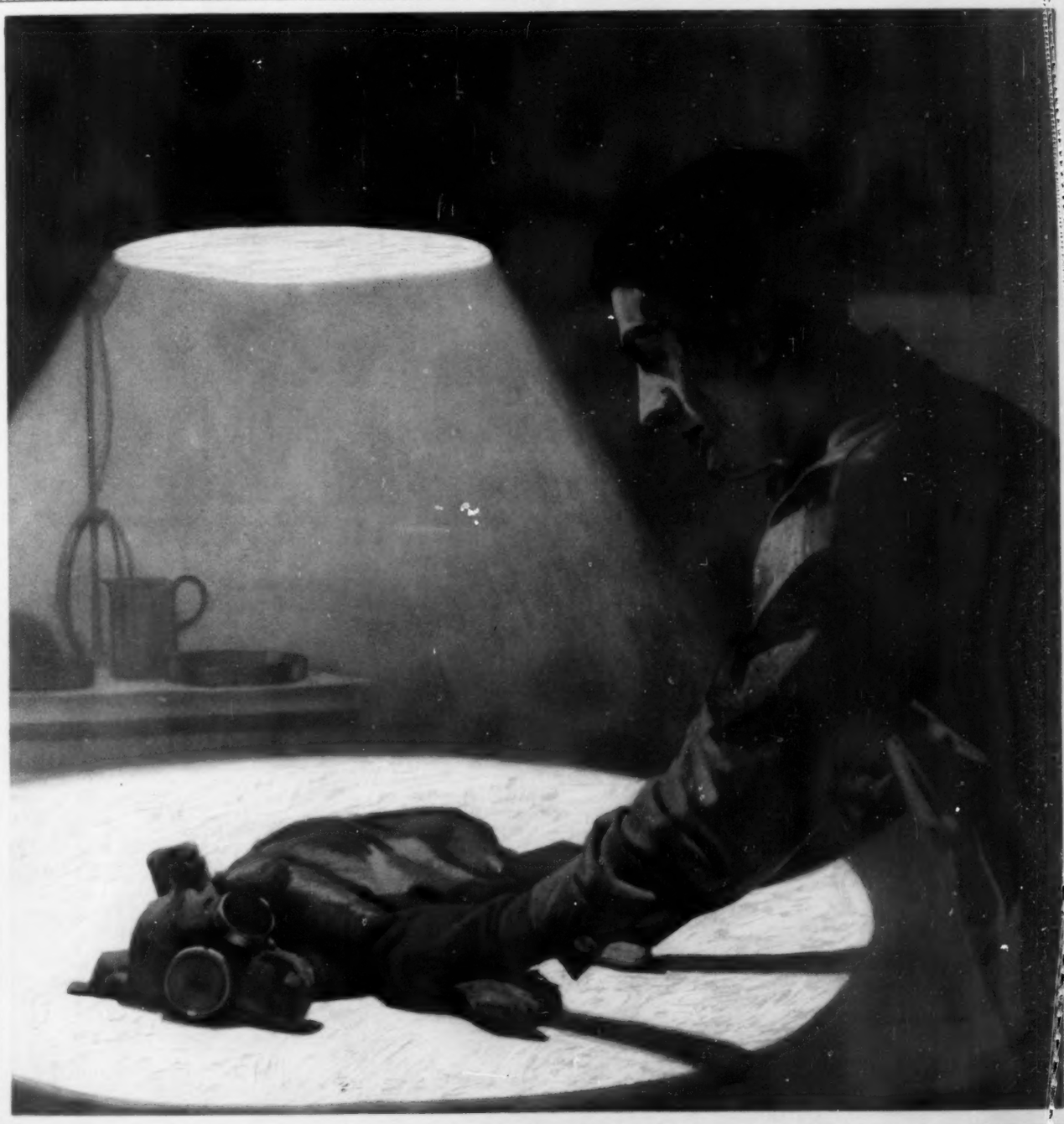
APR 19 1926

SCIENTIFIC AMERICAN

PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

MAY 1926



SCIENCE AIDS MAN'S BEST FRIEND

35¢ a Copy

$4.00 a Year

International Speed Truck Model SL fitted for the grocer's delivery service.

For lighter loads, one of these–

THE Harvester Company is equipped and ready to help you make quick work of your hauling jobs. It offers the International Speed Truck, furnished in three distinct chassis designs.

Model S is a general-purpose truck for regular hauling and delivery. It is built to carry a ton and it comes equipped with any type of body you may need for the work you have to do.

Model SL—safe and low and easy to work with—is a ton-and-a-half underslung chassis with a wheelbase of 150 inches. The top of the frame is only 24 inches from the ground. It is furnished with about every kind of body imaginable, from the simple express type to a coach de luxe, and it is a favorite with owner and driver from every point of view.

Model SD is a handy, specially-built ton-and-a-half dump job with a wheelbase of 110 inches. Because of its sturdiness, speed and easy handling, it is ideal for general contracting, road building and trailer work.

The International Speed Truck Chassis is a versatile and flexible unit. Use the right models for your business and you will get the same satisfaction that other users of International Trucks have been getting for more than twenty years.

The International line also includes Heavy-Duty Trucks ranging from 1½-ton to 5-ton maximum capacities, and Motor Coaches for all requirements.

INTERNATIONAL HARVESTER COMPANY
OF AMERICA
(INCORPORATED)
606 So. Michigan Ave. Chicago, Ill.

INTERNATIONAL
TRUCKS

We are illustrating below some of the popular models of the Speed Truck, S, SL, SD. Write us today for complete descriptive literature on International Trucks and for the names of other firms in your line who are using them.

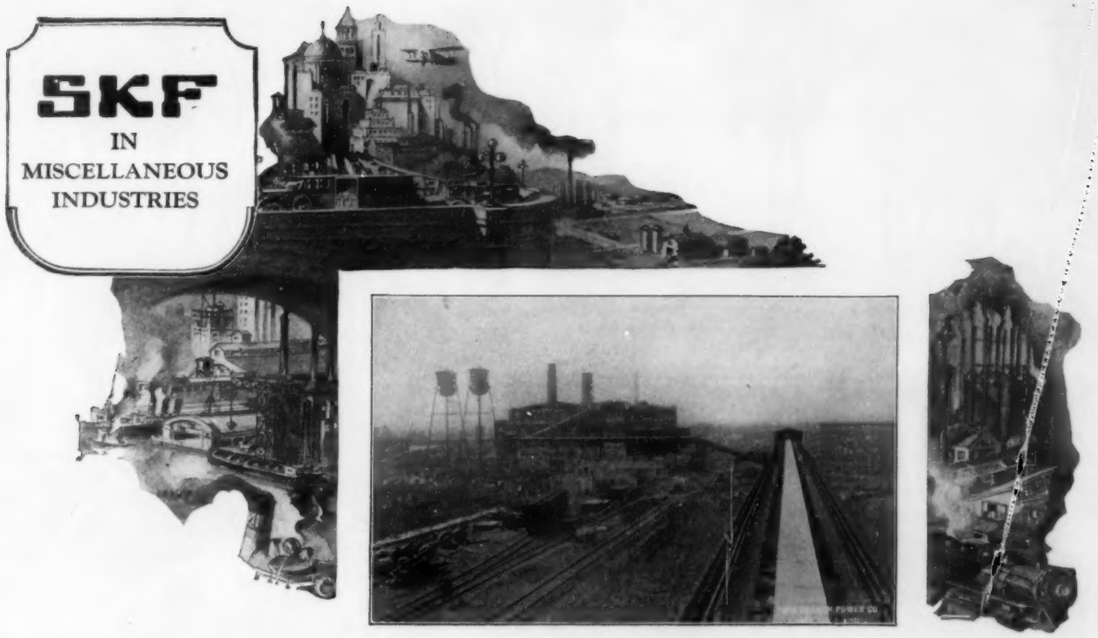
Model S, *Panel Body*

Model SL, *Bottler's Body*

Model S, *Express Body*

Model SL, *Furniture Body*

Model SD, *Dump Body*



"1,500,000 Tons of Coal Moved— Not One Cent for Bearing Repair"*

Actual Certified Survey in your Industry or one closely related to it Sent on Request.

"THE best ball bearing which can be bought is the cheapest in the long run," states the structural engineer of a large power company using a total of 4,500 Skayef Self-Aligning Ball Bearings on their coal conveyors at three plants. The first installation, made over two years ago, a conveyor 855 feet long from coal mine to power plant, has hauled over 1,500,000 tons of coal without one cent for bearing repair!

Compared with the old bearings used, this company is realizing considerable savings in driving power. The increase in current taken by the driving motor from no load to 300 tons per hour was in some cases only 19 percent! But far greater than this advantage is the increased life of expensive belts! Although set up out of doors and exposed to the elements, all the bearings need is an occasional replenishing of lubricant.

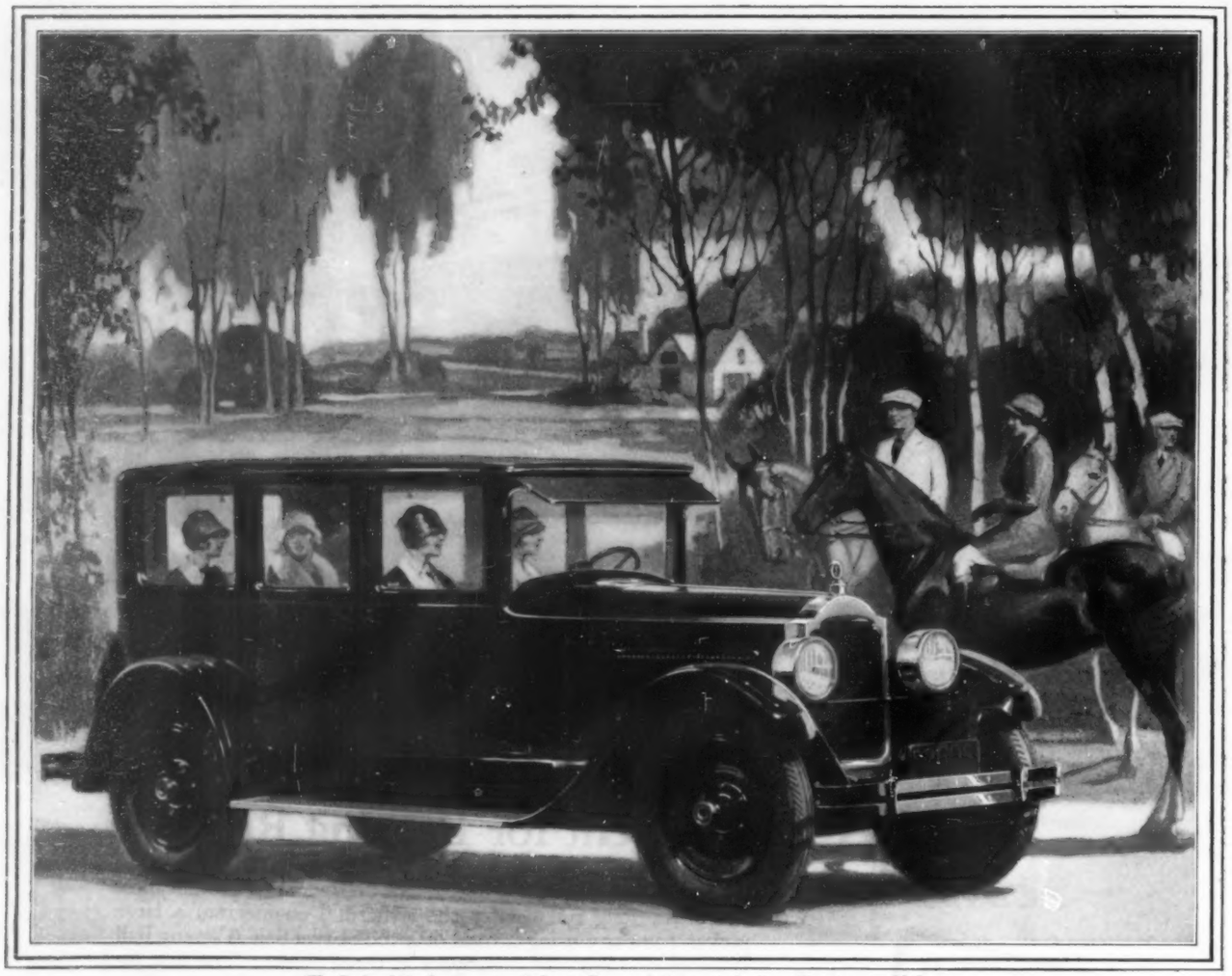
*A certified survey on this installation sent on request.

SKF INDUSTRIES, INCORPORATED
165 Broadway, New York City.

1548

More than 100 Factory Offices Throughout the World
SKF
Puts the Right Bearing in the Right Place
Ball Bearings
Roller Bearings

THE SCIENTIFIC AMERICAN, MAY, 1926. Volume 134, Number 5. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879. Copyright, 1926, by Scientific American Publishing Company. Great Britain rights reserved. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Reg. U. S. Patent Office.



The Packard Six five-passenger Sedan is illustrated. Its cost is $2585 at Detroit, tax added

THE PACKARD MILE COSTS LESS

The average Packard owner drives his car nearly three times as far as the owner of the car most often traded in for a Packard Six.

The depreciation cost per mile is actually more on such cars than on the Packard Six and operating and maintenance charges are never any less.

If it costs less to own a Packard by the mile and no more to run it, why should any one be without its beauty, its comfort and its distinction.

The Packard mile does cost less and does give more than any other mile.

Why be without it when the Packard Six may be bought for a thousand dollars less than most men think and on a budget plan that seldom calls for monthly payments in excess of $150.

PACKARD

Ask The Man Who Owns One

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, MAY, 1926 EIGHTY-SECOND YEAR

PRIZES

EVERY year, the United States Naval Institute offers a prize for the best essay upon some naval subject. There is keen competition for this prize and it serves to bring forth some ably-written and very illuminating work. It gives us much pleasure to announce that the prize essay for 1926 was won by our London correspondent—Mr. Hector C. Bywater—who has come to be recognized as one of the leading, if not the foremost, lay authority on naval matters today. His essay, entitled, "The Battleship and Its Uses," is a concise and compelling argument for the retention of the battleship as the main arm of our naval defense. From his final summing up, we select the last of six propositions, which reads as follows:

"When the torpedo has acquired the range and precision of a 16-inch gun; when submarines have become as swift, as seaworthy, and as habitable as big surface vessels; when the radius and carrying power of aircraft have increased tenfold, and bomb-dropping is as accurate as gun practice: then, but not till then, will the primacy of the battleship be endangered.

EXPERIMENTS

WHETHER we do it to save money or not, most of us get a lot of satisfaction out of making useful things at home, doing scientific experiments, and so on. With our own hands we create the thing previously conceived in our brain, and the thing thus becomes a part of ourselves.

It is with this in mind that the Scientific American has secured Dr. H. H. Sheldon, Chairman of the Department of Physics at Washington Square College, New York University, to conduct a research department for its readers. From time to time he will present some experiment in science, pure or applied, that can be conducted by the intelligent amateur who feels that he would like to give his spare time to something intrinsically more satisfying than the reconstruction of a Ford into a wheelbarrow, and perhaps a little more difficult. Incidentally there are quite a few researches in science that require large numbers of experiments rather than especially trained experimenters.

You are invited to inquire, suggest, criticize and correspond with Professor Sheldon freely. This month he tells how to correct an auditorium having poor acoustics, a neat little job for the man that likes to tackle a real problem. There is at least one such auditorium in every community, but remember the job isn't to be done simply by stringing a few puerile wires across the rostrum.

In This Issue

What Shall We Do About It?
Unless we take pains to provide more scientific workers, our science, our industry and our mechanical civilization is threatened. We must go to the root of the trouble. On page 295 a noted naturalist does this.

More Fish, Fewer Mosquitos
Nowadays about everybody knows that mosquitos transmit malaria and yellow fever. Then get rid of the mosquitos. How? Drain the marshes, say some. Use crude oil, say others. Good, also costly. Prof. David Starr Jordan has an easier method and a far cheaper one. Page 296.

Man's First Tools
As our ancestors evolved in body their culture also evolved. Which of these evolved the faster? Did the two keep pace? These things and others are answered by a well-known prehistorian, Professor MacCurdy of Yale. Page 295.

Fighting Off the Bombing Planes
"A positive and highly efficient system of anti-aircraft defense will be realized during the coming year," declares Col. H. E. Cloke of the Coast Artillery Corps. Commencing on page 302, he tells how army scientists are succeeding in sealing the doom of attacking airplanes.

More and More Powerful Broadcasting Stations
What is the long-distance skip-effect? WJZ, the great new super-station employing fifty kilowatts, has already played some queer radio pranks, puzzling the radio engineers. On page 306, Mr. Orrin E. Dunlap, Jr., describes the equipment with which engineers will strive to solve these problems.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 360.

For Next Month

Speeding Up Nature's Processes
That is what Luther Burbank, the noted producer of new plants, really does. What Nature accomplishes in a million years he accomplishes in a summer or two. In next month's issue Mr. Burbank writes interesting sidelights on some of the remarkable things he does.

What Makes the Sap Rise in Trees?
Did you ever stop to wonder what force pulls and holds tons of sap high up in the trees? We know that trees give off water through their leaves by constant evaporation. Therefore more water must keep rising. Next month Dr. D. T. MacDougal, noted plant physiologist, will explain.

A New Plan to End Auto Congestion
H. W. Slawson, automotive authority, urges a new method that promises to give us all the room our motor cars need on city streets. It means greater efficiency, safety and comfort.

Other articles on The Earth's Internal Heat; Boy Scouts as Scientists; A Precision Balancing Machine; X Rays and Atoms; An Analysis of the Federal Budget; Annapolis; A New Type of Gas Holder; Radio; Astronomy.

MORE THAN 200 PICTURES

¶ **There is one best way to keep in touch with the leaders in the world's progress—by consistently reading the Scientific American.**

$4.00 brings the Scientific American to you for one whole year.

CIVILIZATION

SOMETIMES we are so close to a thing that we cannot make out its full significance. We just take it for granted. Such a thing is the phenomenon which we call "civilization." What is civilization? A remarkable composite of human advances. But where did they come from? Were they in the predestined order of things? Were they bound to come sometime? Not at all. Given a few different circumstances, perhaps involving an element of luck, and man might have lived on and on a million more meaningless years into the future as a savage. But somewhere conditions became just right for a limited group of uncivilized men to "invent" civilization. Professor G. Elliot Smith, who contributes an article to the present issue, believes this discovery was made in prehistoric Egypt. The rest of the world copied.

CREATION?

LAST fall when Professor Millikan announced the remarkable results of his research on the new cosmic ray he hinted at several hypotheses that might be advanced to account for its origin. Said he, "Professor MacMillan of Chicago will wish to see in it evidence for the condensation into matter out somewhere in space of the light and heat continually being radiated into space by the sun and stars," and, he added that this would be, "an altogether permissible speculation."

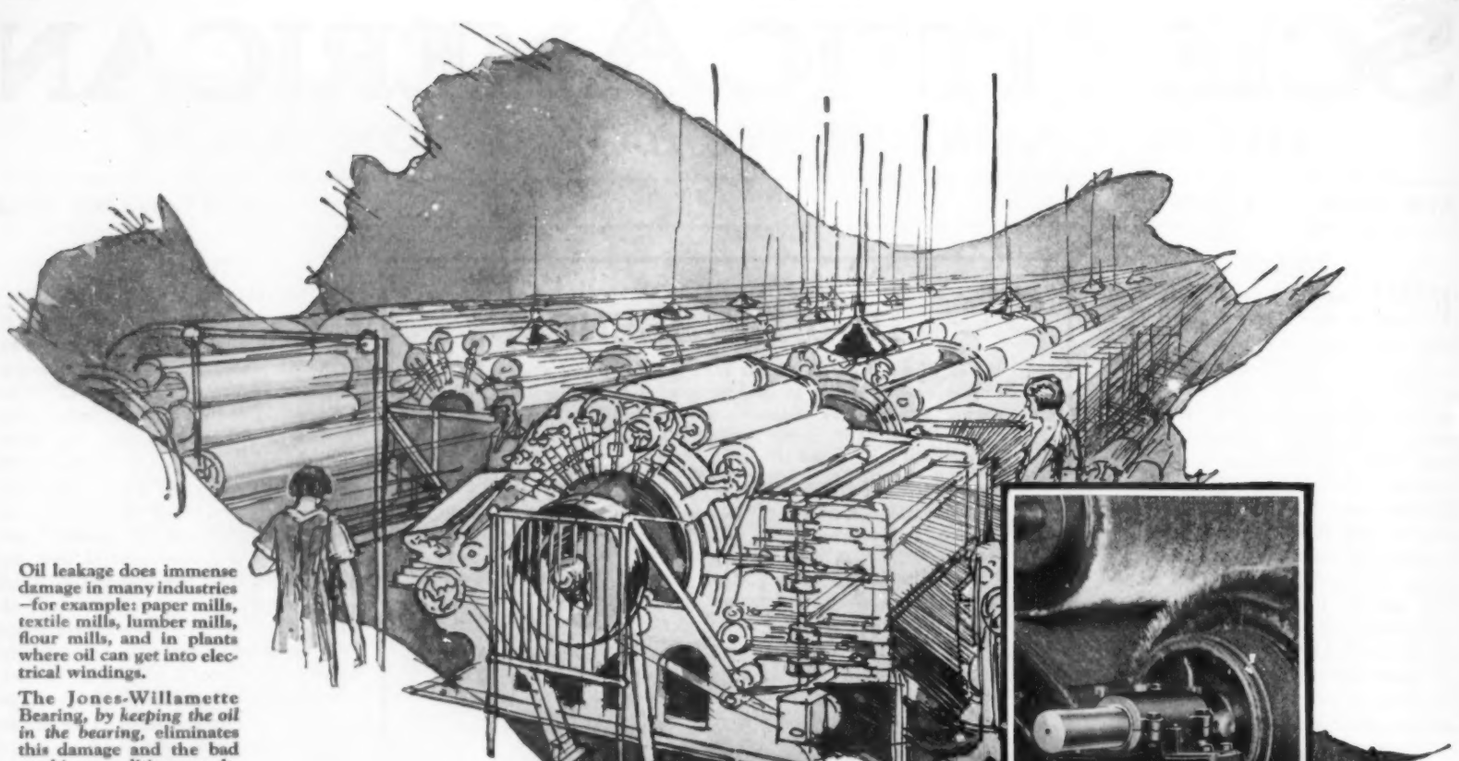
Professor MacMillan was not long in making good on Professor Millikan's prophecy, for the present issue of the Scientific American contains the statement of the MacMillan theory, just as foreshadowed by the noted atomic physicist.

ILLUSIONS

ILLUSIONS? Yes, we all have them, only yours and mine are different ones. Perhaps illusions and "old wives tales" thrive least in the mind of the trained scientist. His rigorous thinking discipline kills them. Even at that, a few scientists fall prey to them. We are acquainted with one scientist who will not walk under a ladder! He says this taboo is founded on actual fact—a pail of paint might descend. Finally he admits being plainly superstitious.

The fact is, it is more pleasant for most of us not to think straight. We all like miracles and we love our other little irrationalities dearly.

This being characteristic of human nature we do not envy the author of the iconoclastic article on "Nature Faking," in the present issue. His mail will probably sizzle.



Oil leakage does immense damage in many industries—for example: paper mills, textile mills, lumber mills, flour mills, and in plants where oil can get into electrical windings.

The Jones-Willamette Bearing, *by keeping the oil in the bearing*, eliminates this damage and the bad working conditions resulting from dirty, oil-soaked floors.

Wherever oil leakage can damage goods in production *you need these* oil tight bearings

OIL TIGHT
LESS FRICTION
LASTS LONGER

Action of shaft automatically filters and circulates oil to points of greatest load and friction. Complete lubrication means long life. Bearing completely oil sealed—oil cannot escape nor water enter.

Distributors: A few good territories are still available. Write or wire.

Does oil leakage from bearings and the resultant damage to materials and machinery in your plant constitute a serious problem?

It does in many leading industries.

Even if your machinery and the goods you manufacture are such that they are not harmed in this way, there is the ever present fire hazard of oil soaked floors and oily waste materials—not to mention the annual wastage of costly lubricating oil.

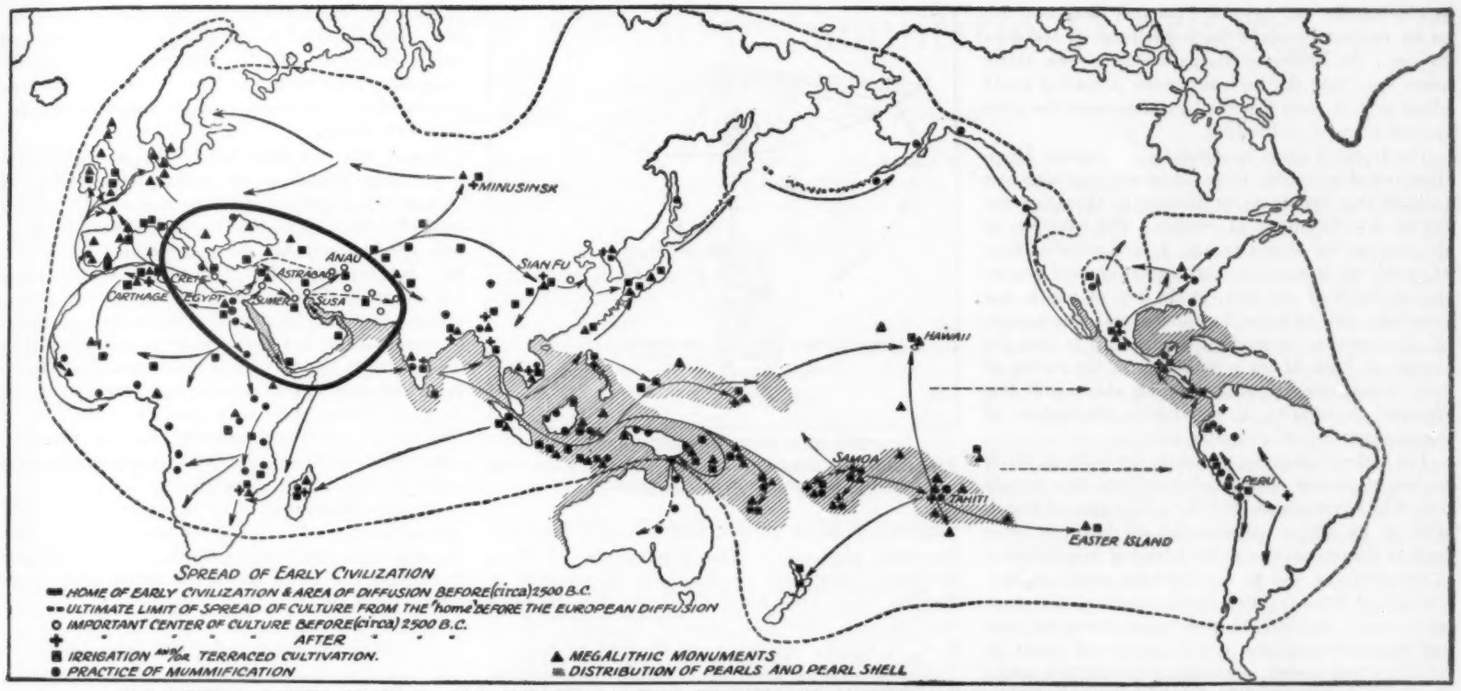
Jones-Willamette Bearings solve this problem on the simple principle of keeping the oil *in* the bearing, instead of letting it work out at the ends, which happens in bearings of every other type.

There is no better way of demonstrating what we mean than by installing one or two bearings in your plant on 60 days' trial, where you can watch them work—and where you can check the immediate oil savings, as well as the most substantial power savings due to decreased friction. A letter from you and we will take the matter up in greater detail.

Willamette Iron & Steel Works, Portland, Oregon

Monadnock Bldg., San Francisco — L. C. Smith Bldg., Seattle

[Jones] Willamette Bearings



THE GENERAL ROUTES BY WHICH THE CIVILIZED CULTURE INVENTED IN ANCIENT EGYPT SPREAD THROUGHOUT THE WORLD

Did civilized culture start in one place and spread, or did it start up independently in several places? Here is a rock on which ethnologists split. The majority argue for several independent origins. The growing minority, of which the author of the article below is the recognized leader, argue for one place of origin and subsequent diffusion. The map above depicts the spread of early civilization from ancient Egypt, while Professor Smith's article demonstrates it by tracing certain peculiar types of ships through various periods and to various places

Ancient Mariners and the Spread of Early Civilization

By Professor G. Elliot Smith
University of London

PERHAPS the strongest confirmation of the reality of the widespread diffusion of culture that began as soon as civilization itself was invented is provided by ancient ships and their survival in modern times. For the very business of a sea-going ship is to travel abroad and establish cultural relations with countries beyond the frontiers of the ship-builders' homeland. Fortunately, there has survived in most parts of the world ample evidence of the range of particular types of ancient vessels, the invention of which can be assigned to perfectly definite periods in time.

In very remote times, men were able to cross streams with the help of logs and floats of various kinds, and eventually by means of dug-outs. The mere fact that the ancestors of the Aboriginal Australians were able to make their way into Australia many centuries ago—exactly how long ago we have no evidence to decide—implies that these primitive people must have crossed one or more sheets of open sea.

In very early times many varieties of floats were invented by different peoples. The Babylonians made great earthenware pots, such as are still used in Mesopotamia today. They also made rafts, the buoyancy of which were secured by means of floats, either goat-skins distended with air, or pottery vessels. But it is a very interesting and significant fact that most of the ancient boats, and especially sea-going ships, found in almost every part of the world conform in most cases to one very distinct type, the history of which can be discovered in Egypt.

In order to cross the Nile, the Egyptians, certainly as early as the fourth millennium, nearly sixty centuries ago, constructed floats by tying together bundles of papyrus. These floats assumed a very characteristic form, which was determined by the nature of the material and the method of construction. When the Egyptians attempted to make more substantial and larger craft, and replaced the fragile papyrus by logs of wood, they still retained the old form of the papyrus floats and used the same method of construction; that is, they tied together the logs with string and rope, so that they did not speak as we do of "building" but of "tying" a ship.

The Ship Was Invented in Egypt

The peculiar form of the stern and of the prow of these early ships was determined by such considerations as I have mentioned, and afford irrefutable evidence that the invention of ship-building was made upon the Nile, and that at first timber did not enter into the composition of the vessels.

When the Egyptians began to build more substantial ships they first used the sycamore wood of their own country; but from such experience they soon learned to appreciate the need for better material for their work. In fact, the earliest sea-going expeditions of which we have any record had for their object the getting of timber from the Lebanons for ship-building as well as for other purposes. What most people who have discussed this problem seem to have overlooked is the fact that these great undertakings would not have been made except by a people who had already learned to appreciate the value of good timber after using the poorer material of their own country.

It is a very remarkable fact that writers on the early history of civilization—even, in some cases, scholars perfectly familiar with the Egyptian evidence—make the statement that the ancient Egyptians were not given to maritime adventure. Before the time of the Cretan ascendency in seamanship, the only people of antiquity who were known to have built sea-going ships (the ships of the Cretans were clearly imitations of Egyptian ships) were the ancient Egyptians themselves. The archaeological evidence is emphatic that the Egyptians were in touch with Crete, which necessarily involves the fact that they were trafficking with Crete by sea.

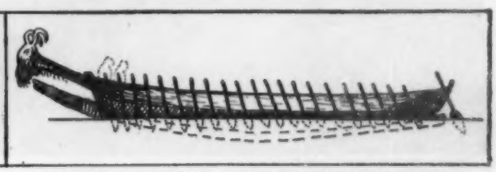
But the Egyptians have put on record not only the fact that they regularly sent expeditions on the Syrian coast (and right down the Red Sea as far as

ANCIENT EGYPTIANS MAKING REED FLOATS

Six thousand years ago the Nile navigators originated the raised prow and stern. It has come down to our times

LIKE THE SHIPS OF TUT-ANKH-AMEN'S DAY

This Egyptian type of ship was found engraved on rocks in Sweden. Note the distinctive type of raised prow



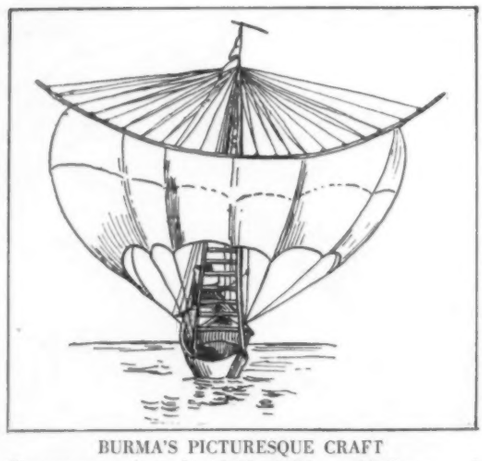
A SIMILAR MODERN TYPE FROM UGANDA

Compare this craft with those at the left. The ancient Egyptian type of craft spread far and wide

Bab-el-mandeb and beyond), but they have also left us the earliest stories of the experiences of travelers by sea. As Professor Maspero stated some thirty years ago: only the most inveterate prejudice could blind us to the fact that the Egyptians were the great seamen of early civilization.

The types of ships invented by the ancient Egyptians reveal a number of peculiar and characteristic features that enable us to distinguish those belonging to definite historical periods. For example, at the time of the first Dynasty, a very peculiar type of vessel was being built with a great upward projection in front of the bow, to the top of which was attached a pair of horn-like appendages. The interest of this peculiar appendage to the ship is that the natives of East Africa now living on the shores of Lake Tanganika are still building ships with this identical peculiarity, a remarkable illustration of the conservatism of primitive people.

The earliest sea-going ship with the form of which we are at present acquainted goes back to a remote period in Egypt, about 2800 B. C. This type of vessel, with all its curious peculiarities of detail, is being built at the present day in the island of San Cristoval at the southern end of the Solomon group in Melanesia. A slightly later modification of this type, with a very peculiar high stern, an A-shaped mast and distinctive rigging is still preserved intact in Burma, where vessels, conforming strictly to a model that became extinct in Egypt (where it was invented) more than forty centuries ago, are used today to bring rice down to Mandalay.



BURMA'S PICTURESQUE CRAFT

The same type of vessel, with identical form of hull, mast and rigging, was used in ancient Egypt, 2600 B. C.

How Civilization Reached the World

Coming to a later period, we find a distinctive type of ship used by the officers of Tut-Ankh-Amen to collect tribute, not only on the upper reaches of the Nile in the Sudan, but also by sea from the coast of Syria and the isles of the Aegean. These ships, made in the 14th Century B. C., are of peculiar interest to the anthropologist because the earliest representation of a sea-going ship in Western Europe (engraved on rocks in Sweden by the people who introduced the Bronze Age culture to Scandinavia, an event to which Professor Montelius assigns the date 1000 B. C.) is a perfectly definite illustration of the type of ship used by Tut-Ankh-Amen's seamen. This type of vessel is still being made at the present day by the natives of Uganda.

The discovery has recently been reported of ancient pictures of ships carved upon inland rocks in New Zealand, which differ in type from the known Maori boats, and are described by their discoverers as "resembling Greek galleys, with ramming beak and boarding platform." The photographs of these sculptures, like those of the Early Bronze Age in Sweden, leave little room for doubt that the same type of ship (that distinctive of the 14th Century B. C., in Egypt) was the model for these pictures.

And so passing down the ages one can establish an unbroken chain of events to prove that the types of ships used at successive periods by Cretans, Phoenicians, Romans, Arabs, Indians, Malays, Chinese, Melanesians, Polynesians, the Pre-columbian people of Central and South America, and in medieval and modern times by the great European sailors, all exemplify the persistent influence of the naval architects of ancient Egypt, who determined the form and the method of construction of the ships and developed the rudiments of seamanship.

One must not assume that primitive people overcame the terrors of the sea and all the difficulties and displeasures of sea-travel simply from the spirit of idle adventure. It required a very powerful incentive, involving the question of life and death and the issue of prosperity or adversity to impel men to risk so much.

The Egyptians went to Syria to get timber and resin, partly because they had begun to appreciate the economic value of these materials, but mainly because these substances were used for the protection and preservation of the bodies of the dead, and thereby were regarded as divine in the sense that they were the instruments for perpetuating the bodies of the dead, which was at first regarded as the essential condition for the prolongation of the dead man's existence. Similar motives inspired expeditions down the Red Sea to East Africa and Southern Arabia where even more valuable preservative materials were found.

But it was not long before the quest of other things came to play a part in the process: gold and copper ore, a variety of spices and precious stones were all being sought after more than forty centuries ago, not precisely for the purposes for which men have been searching for these substances ever since, but primarily because they were regarded as divine, in the sense that they confer on mortals the boon of immortality. It was this magical factor that gave the glamor to the search for these materials. It has prompted men throughout the ages, right up to the time of Christopher Columbus, to seek for the "Islands of the Blest" and the "Earthly Paradise" where gold and jewels and other precious substances could be obtained in abundance.

By such means, more than by any other, the world in ancient times became linked together by a bond of common endeavor, and there were diffused throughout the whole world the germs of one common civilization.

An Important Scientific Question

I have not attempted here to give bibliographical references for the literature, as it is so immense in extent. In 1917 I attempted to do so in a pamphlet entitled "Ships as Evidence of the Migrations of Early Culture" *(Manchester University Press)*. I gave a summary of this more extensive paper in an article, "Ancient Mariners," in the *Journal of the Manchester Geographical Society*, 1917, which was still further summarized in Chapter XII of my book "The Ancient Egyptians," 2nd. Edition (Harpers, 1923), see p. 177. In Chapter V of my book "Elephants and Ethnologists,"* 1924, a brief account is given of the evidence of ancient maritime adventure in the Pacific Ocean, with the object of demonstrating how intimately the coasts of America were linked up with Eastern Asia, the Malay Archipelago and Oceania during the first twelve centuries of the Christian Era.

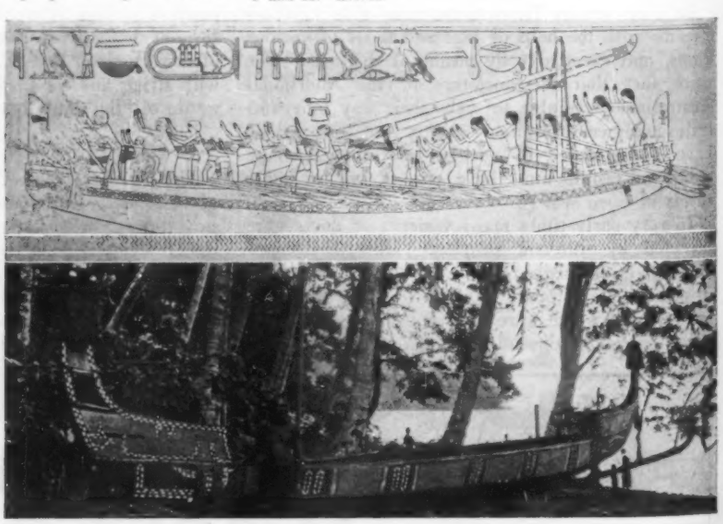
An independent demonstration of the vast significance of ancient Egyptian ships and shipping has been given by Mr. W. F. Egerton in the *American Journal of Semitic Languages and Literature*, Vol. 39, 1923.

* Reviewed in Scientific American, January, 1926. See pages 3 and 11.—EDITOR.

Courtesy of the "Illustrated London News"

ROCK PICTURES, RECENTLY DISCOVERED IN NEW ZEALAND

Here again is the raised prow and stern. The same general type of ship was distinctive of Egypt in the 14th Century B. C. Thus it has spread thousands of miles to the east



ANCIENT EGYPTIAN AND MODERN MELANESIAN SHIPS

ABOVE: *the earliest known picture of a sea-going ship, built in Egypt about 2800 B. C.*
BELOW: *the same type built at the present day in the Solomon Islands*

How Can We Produce Scientific Workers?

By T. D. A. Cockerell

Naturalist, and Professor of Zoology at the University of Colorado

"AT eight and one-half years old, I went to Mr. Case's school. By the time I went to this day-school, my taste for natural history, and more especially for collecting, was well developed. I tried to make out the names of plants, and collected all sorts of things, shells, seals, franks, coins and minerals. The passion for collecting—which leads a man to be a systematic naturalist, a virtuoso, or a miser—was very strong in me and was clearly innate as none of my sisters or brothers ever had this taste."

CHARLES DARWIN.

"As to my interest in biology, I can trace it, I think, to two very trifling facts. I doubt if I had or have any *special* aptitude for it, but I have a natural love for *classification* and an inherent desire to *explain things;* also a great love of beauty of form and color. The two slight facts are these. When a boy at school, I heard a Quaker lady say that she and some friends had found the 'monatropa' which was quite a discovery as being before unknown in the district. This, and hearing the names of other flowers referred to as rare, made me think it would be very interesting to know the names of all the plants that grew wild. . . . The other incident was meeting H. W. Bates at Leicester and being started by him as a beetle and butterfly collector."

ALFRED R. WALLACE.

Within the last quarter of a century, there has been an enormous increase in the number of college students in America. At the same time, the applications of scientific discovery and invention have changed the very aspect of our civilization. According to the United States Public Health Service, the annual death rate per hundred thousand in the United States has dropped in 20 years from 1,755 to 1,288. The applications of science are keeping us alive, raising our standard of living, and bringing us conveniences and luxuries previously undreamed of. Large sums of money are given to scientific institutions and some of the results of their activities are eagerly received by the public and widely discussed.

More Help for Pure Science

In the face of all this, it seems superfluous to ask how we are to produce scientific workers. Have they not been produced in ample numbers, and are they not working day and night to bring forth still other wonders for our delectation? Is it not true that the crop is ripe and being harvested, while we, the public, have only to present ourselves at the banquet table to be fed?

Actually, the matter is not so simple or satisfactory. The material benefits of science are not the only benefits. If we study any one branch of science, we find that the active and fruitful research workers are extremely few, except in those departments which are stimulated by commercial profit. Look at it from any angle and you have the spectacle of a very small minority feeding the great multitude, often under difficulties. This minority is so efficient that progress is rapid, perhaps more rapid than is altogether good for us. In the meanwhile, the people as a whole have little of the true scientific spirit such as animated those great naturalists of the past century, Darwin and Wallace. So little indeed, that they will not even create adequate faculties for those who are actually doing the work.

In my special field of zoology, there is not even a catalogue of the animals of the United States. No serious attempt is made to completely organize the knowledge we possess or extend it according to a general plan. The existing journals are having a hard time to exist and often have to be subsidized by their editors. The publication of the results of research is a problem which is daily becoming more acute. There are important groups of animals which are being studied in this country by one, two or three people, some by none at all.

But if so, what of it? Have we not the radio, the airplane, the moving picture, and a thousand other things, and what does it matter how many kinds of beetles are living in New York State, or how they are related to one another, or how they came to be where they are? Let us have some sense of proportion and cease to worry about facts which, left to themselves, will assuredly not worry us.

How to Create Scientists

Science, a comparative newcomer in human history, is remaking our world. It is doubtless providing an unimaginably brilliant future for mankind. Who, then, are they that shape its course, holding within their grasp our destinies? They are a mere handful of men, a few scant thousands out of two billions of humans, few of whom are even aware what is being provided for them.

Science will pay back inconceivable riches, therefore let the world invest more deeply in it; first we must produce more scientific workers. How? By planting scientific thoughts in the minds of our children. How this worked out in the case of Darwin and Wallace, Prof. Cockerell demonstrates by the opening quotations.

This cynical attitude is not peculiar to the masses; indeed, it finds clearest expression among those who are generally considered to be highly educated. One of the best men I ever knew, a college president, felt exactly that way. In attempting an answer, I must accept the pragmatic attitude and agree that the things mentioned are of no consequence if it is a fact that they furnish nothing of value to mankind. I will not even take cover under the familiar retort, that as Franklin said, no one can estimate the potential value of a new-born baby. In this case, I will consent to infanticide if it can be established that the infant has no value at the present time. But this is a doctrine, unspeakably odious to its mother, who daily and hourly receives benefits of a transcendental nature.

Perhaps the analogy of the mother may serve to clear our thinking. We maintain, in fact, that scientific interest and activity are worth while as direct sources of pleasure and intellectual culture. They make the man, without which as Edwin Markham said, "these cities glorious" are of no avail. It is hardly too much to say that the moral benefits of science are much more important than the material ones; and it may be true in a new sense that if we seek the kingdom of heaven first, all else shall be added unto us.

The Rev. William Kirby, an eminent entomologist, wrote in 1800: "The author of scripture is also the author of nature and this visible world, by types indeed and symbols, declares the same truths as the Bible does by words. To make the naturalist a religious man, to turn his attention to the glory of God, that he may declare his works in the study of his creatures, see the loving kindness of the Lord, may this in some measure be the fruit of my work." While we no longer use the phraseology of the Rector of Barham, it still remains true that the study of the work of nature is an efficient means of education, if by that term we mean the development of the desirable qualities of mankind. It is, as the good Rector maintained, the path to true religion, if that word implies a sense of the wonderful order of the universe which we must understand if we would successfully govern our own lives. Thus, and not otherwise, may we attain virtue. In that sense, the scientific and religious attitudes are one, and we can look back with veneration on those religious teachers of the past who were striving to bring man's mind into harmony with the ruling spirit of the universe.

To abandon the supernatural and question man-made dogma is natural in the light of that cleaner vision which is the product of long years of effort to understand "the author of nature." We are but continuing what was begun long ago, and in all humility, we recognize that posterity will amplify and correct our still imperfect philosophy.

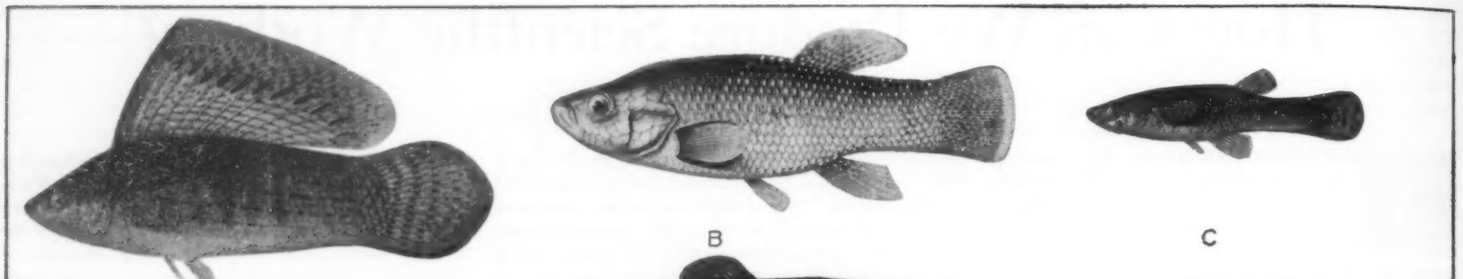
Boys Are Potential Scientists

Perhaps we may now, a little more acceptably, ask again how we may produce more scientific workers? How may we raise up a nation of people genuinely interested in natural phenomena, and especially in the processes of life? How may we attain that sort of scientific virtue which makes us see things as they really are and desire to solve human problems according to their real merits? How may we make scientific observation a social function, so that it makes good fellows, bound together by the kindness of a common interest? No doubt, the key to this problem is with the child. Wallace and Darwin and many others like them, refer to very early influences, very early developing aptitudes. It was certainly so in my case, and I can never be too grateful to those who gave me intelligent encouragement and sympathy instead of the too common disdain or hostility.

I cannot be too grateful to those who wrote and those who published cheap little books which were my inspiration and delight, Greene's "Insect," Hunter's "Companion," Coleman's "British Butterflies" and the translated "Insect World" of Figuier. I cannot forget the inspiration of the museums, especially the great British Museum, to contribute to which was one of my highest aspirations.

No matter how strong the inborn taste, it needs to be shared with others, or fostered by the sense that others have felt the same. The beginnings must be voluntary, part of the play activities of childhood, ripening into more systematic and purposeful efforts in later years. When there have been no such beginnings, it is difficult to stimulate the faculties which have already begun to atrophy, crowded out by others which have taken precedence. This may in a large part account for the disappointing sterility of the colleges, which are certainly not giving us the intellectual types we thought we had a right to expect.

Is it possible by taking thought to add one cubit to our scientific statue? Assuredly, it is only possible to develop innate faculties, but all observation indicates that these are too easily suppressed or crowded to the wall. We are not getting the results which our natures permit or would permit under favorable conditions. Those favorable conditions can be created if we have the will, but we must first have the grace to understand.



SEVERAL TYPES OF FISH WHICH HAVE BEEN TRIED IN AN EFFORT TO EXTIRPATE THE MALARIA MOSQUITO

A: Mollienesia latipinna *Le Sueur, a beautiful little fish which was taken from Galveston to Honolulu. Being a vegetarian, it proved to be a failure.* B: Fundulus grandis *Baird and Girard, a Gulf killifish, also a failure as a mosquito devourer.* C: Gambusia patruelis *Baird and Girard, the female of the mosquito fish, which makes short work of mosquito larvae; natural size.* D: Anableps *dowi, the four-eyed fish, from Tehuantepec, Mexico, also a mosquito eater. It swims on the surface, its eyes being divided by a cross-partition, the upper half for seeing in the air.* E: Goodea luitpoldi *Steindachner, a Mexican killifish allied to Gambusia. The eggs develop within the body; half natural size.* F: *Gambusia (gravid female)*

Malaria and the Mosquito Fish

A Plan to Exterminate Malaria by Means of a Fish that Eats Malaria-carrying Mosquitos

By Dr. David Starr Jordan
Chancellor Emeritus, Leland Stanford Jr. University

ONE of the most useful discoveries of the Nineteenth Century was that of the nature of malaria, with its kindred diseases, yellow fever, dengue and the like. It has been found that malaria is not a product of miasma as the accepted name of "bad air" would signify. Neither is it "catching" in the ordinary sense of propagation by contact. It is borne from one person to another by the bite of mosquitos. The big mosquitos of the north may offend by their abundance, their vociferous song and their vicious bite, but they do not carry disease. The dangerous ones are smaller, less insistent, and with a softer voice, but they are much more likely to be poisonous.

The cause of malaria of all sorts, ague, chills and fever, and of dengue, and yellow fever, is the presence in the blood of multitudes of minute, parasitic animals, which at intervals breed in prodigious numbers, with corresponding but varied discomfort. The biting of a man having malarial trouble, by a mosquito of a certain particular kind (known as Anopheles), transfers one or dozens of these creatures to its own body, causing it, no doubt, lamentable discomfort. Later the mosquito may bite another person "to take the taste out of his mouth." This next victim receives another bite and perhaps a third, thus passing the malady along through the agency of the mosquito's body.

DR. JORDAN IN HONOLULU, HAWAII
Planting the Japanese Ayu, by sinking a box of the eggs, with holes for the escape of the hatched fish

The Problem Stated

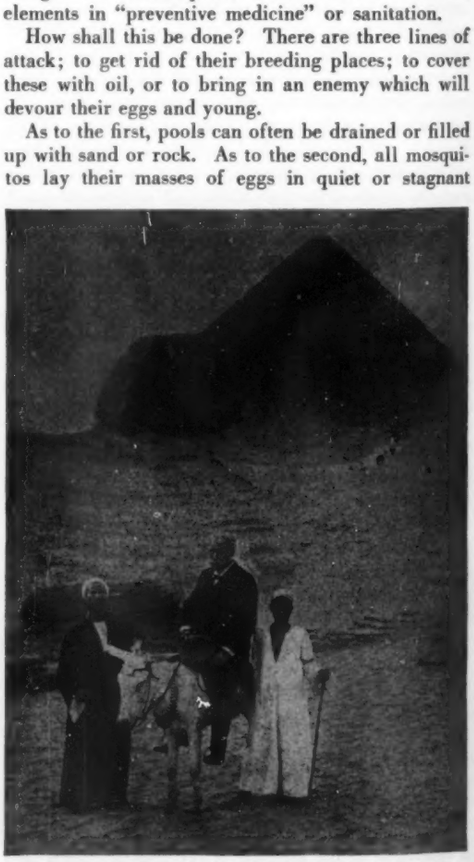
The problem of the cure of malaria is for the most part bound up in our skill in poisoning the malaria with the least damage to their human host. Thus far the most successful method has been the use of salts of quinine. This extract from "Peruvian Bark" from the Cinchona tree of South America, is fatal to all the malarial microbes with which it comes in contact. It is not a very wholesome drug as far as man is concerned. The main point is that it kills the microbes without killing him.

But prevention is always better than cure. The way to put an end to malaria ravages is to extirpate the mosquitos. In rainy regions this is hard to do, but the worst kind of mosquitos belong to the tropics or to regions just north of the Tropic of Cancer. They are often virulent in swamps, but apparently equally so in drier regions not connected with jungles. Thus certain districts in the Ukraine, in Macedonia, in Greece and in Southern Italy, have been historically notorious. The Campagna of Rome, and "Five Fingered Sparta" are classical examples of the undoing of populations by mosquitos. The "fading of the glory that was Greece" due primarily to her suicidal wars, was also in large part, the work of mosquitos. I know personally something of their havoc in Macedonia and I am told that in regions about the Black Sea the plague is still more virulent.

The work of our naval surgeons, Reed, Lazear and their associates, in the cleaning up of fever-stricken Havana, followed by work in Vera Cruz, Guayaquil and other poisoned ports, is a classic in medicine. To get rid of mosquitos is now one of the first elements in "preventive medicine" or sanitation.

How shall this be done? There are three lines of attack; to get rid of their breeding places; to cover these with oil, or to bring in an enemy which will devour their eggs and young.

As to the first, pools can often be drained or filled up with sand or rock. As to the second, all mosquitos lay their masses of eggs in quiet or stagnant



"DAVID STARR JORDAN AND THE 40 THIEVES"
Thus does the author caption this picture. Dr. Jordan's strongest interest is in ichthyology

water, in which they hatch. A layer of petroleum over the water will smother their larva or "wigglers" and will also prevent the winged insect from ever escaping. But there are many bodies of water in which neither of these methods can be used. In such cases, the mosquito-eating fishes are the best resort. A good many kinds of little fishes will eat mosquito eggs or larvae when they find them convenient. Sticklebacks, young trout, some minnows, even gold fish do this to some extent. But what is needed is a kind of fish that makes mosquito killing its chief business, which enters on it with alacrity and which will not or cannot harm other more choice kinds of fish.

These desired traits are found in perfection in the "top minnows" or "Gambusinos" of the genus Gambusia. Of this genus there are numerous species in warmer parts of America. Most of them belong to coast streams of eastern Mexico and farther south. Two of them, very much alike, range through our South Atlantic and Gulf States. One of these, *Gambusia patruelis*, is found from Alabama and Texas to Southern Illinois. Another, *Gambusia holbrooki*, extends from Georgia north to the lake of the Dismal Swamp, in Virginia. A third, *Gambusia affinis*, belongs to the Rio Grande region. In Cuba, such little fishes are called "Gambusinos" hence their scientific name, "Gambusia." When an angler returns without fish, the Cubans say, "he has been fishing for Gambusinos."

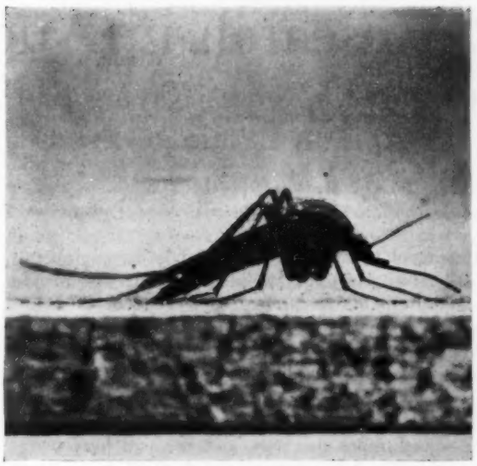
A Successful Attack

Old travelers may remember that Hawaii, twenty and more years ago was cursed by mosquitos. Large ones *(Culex)* brought from Alaska by whalers in their water tubs, in the days when Hawaii was their chosen winter resort, ruled the islands by day, and a smaller one, probably from California, was listened to at night.

Mark Twain, at the old Hawaiian Hotel felt this grievance, and in a characteristic way set out to remedy it. Everyone slept at night under a mosquito canopy and every night some of the smaller insects crept through the meshes. Mark waited one night until all the mosquitos came in through the netting and then slipped out and slept on the floor.

But even this shrewd device often failed. At last, in 1904, the City of Honolulu (knowing the present writer to be a fish sharp), sent a credit of about fifteen hundred dollars (of which about six hundred was used) asking me to discover and send to the islands a fish that would really eat mosquitos.

A California student will tackle any problem, and so I sent out Alvin Seale (then a senior at Stanford, now superintendent of the Steinhart Aquarium in San Francisco). He was instructed to go to Louisiana, and to enter the bayous to test out three species which might meet the demand. Each of them ate mosquitos but in no case had their efficiency been tested. New Orleans was then once more in the throes of yellow fever, so Seale moved across to Galveston and filled his milk cans with the chosen fishes. These creatures are all very hardy, and very few died on the voyage to Hawaii.



ÆDES SQUAMIGER

A harmless salt-marsh mosquito. No mosquito that rests horizontally when it bites is a bearer of malaria

Arrived at Honolulu, each species was tested out in aquarium tanks in drug-store windows, each one filled with stagnant water, stocked with mosquito eggs. The largest fishes, *Fundulus grandis* showed little interest in the matter. They were poured into a pool and have not been noticed since. The next species *(Mollienesia latipinna)*, did a little better. This is a very handsome little fish, with high fins and varied colors. But it is mainly a vegetable feeder, preferring "frog spittle" *(Confervae)* to insects, and seemed not little likely to satisfy. It now abounds in the waters about Honolulu, where it is valued as an aquarium-fish and is largely caught for bait.

The third set of fishes *(Gambusia patruelis)*, rose at once to the occasion, and almost instantly cleared the aquarium of mosquito eggs and wigglers. It is, no doubt, the greatest mosquito killer in existence. It has lived and multiplied in all available waters in Hawaii. It swarms in irrigation ditches and in pools in the rice fields. It is so abundant that it is now gathered up in nets, baked and crushed as food for the fishes in the Waikiki Aquarium. It does not migrate to the sea, and it does not attack other fishes.

In a recent visit of two months in Honolulu, I saw but six mosquitos, all of them small, and no doubt hatched in rain pools or tin pans or other small bodies of water, which the most assiduous fish cannot reach.

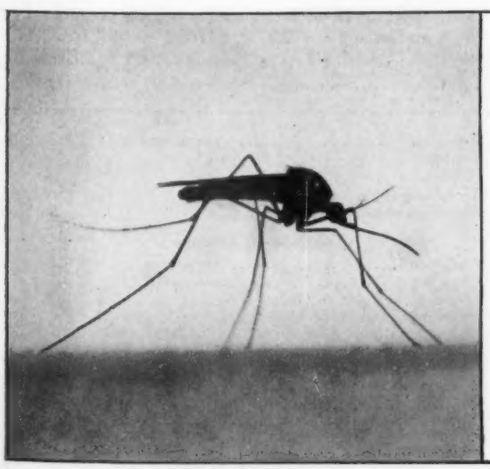
From Honolulu the fish has been taken to Formosa, from which island specimens have been sent back to me. It has gone on to Luzon with equal success, and no doubt to Southern Japan and China, and ultimately I hope, to all around the world. A native of warm regions, it is not certain how much cold it will stand. Last winter, in California, the temperature dropped two or three times to about 30 degrees, but none of the fish seemed to suffer. In October they slip to the bottom, in mud and weeds to keep their little toes warm, but the younger members of the flock may be seen near the surface in any of the so-called winter weather of Central or Southern California. Whether they would live if the surface were frozen over we do not yet know. They feed on flies and mosquitos by choice, rejecting wasps, beetles, butterflies or larger insects. I have seen them leap out of the water to seize an incautious fly alighting on the edge of their pond.

These fishes are light brown in color, without conspicuous markings anywhere. The female is two and one-half inches long, the male rarely more than an inch. About ten females are born, to one male. The eggs are hatched in the body of the female, six to ten in one brood, there being four or five broods between March and September. The young when born are transparent, with big black eyes, and are about a fifth of an inch in length.

Little Fish, Big Appetite

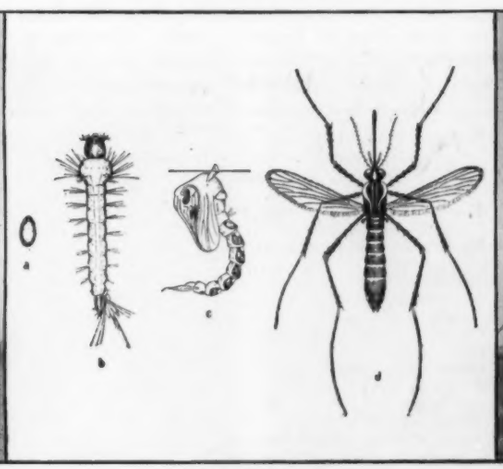
The *Gambusia* is extremely hardy. It will thrive in any still water, not too cold. It flourishes in the gutters of Vera Cruz and other dirty cities in which a ditch along the street takes the place of the sewer. So far as I know there is no first-class, mosquito-eating fish in any waters of Europe, certainly none where it is most needed—about the Mediterranean and Black Sea. The writer has urged on the Red Cross and other good people charged with the sanitation of these districts to introduce and try out the *Gambusia*. It would be easy to transfer a few tanks of them to Greece or Sicily or the Crimea. An artificial pond of two or three rods in diameter, stocked with water plants or even frog spittle, would in a very short time meet any demand.

With this little fish active in the pools and swamps of Southern Europe, thousands of lives could be saved, and millions of others rescued from perennial misery.



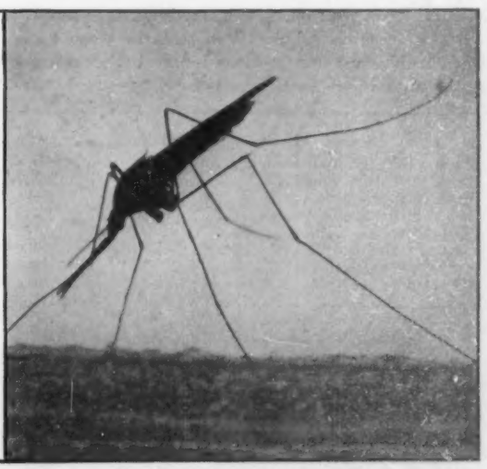
CULISITA INCIDENS

The body of this common mosquito is horizontal when biting, giving assurance that it will not transmit fever



ÆDES AEGYPTI

This is the well-known yellow-fever mosquito which has caused the death of many millions of human beings



ANOPHELES MACULIPENNIS

This is the American malaria mosquito. It may be easily distinguished because it stands on its head when it bites

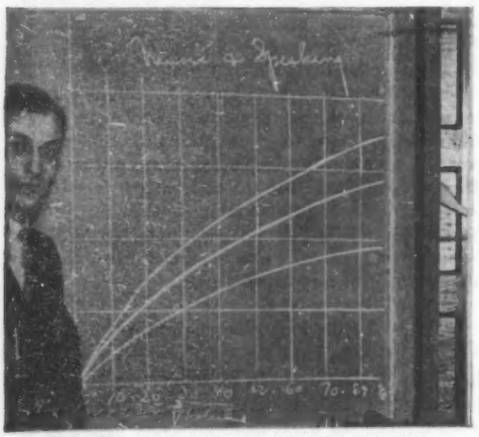
Acoustical Research in Auditoriums

By Making a Scientific Study of Rooms Having Bad Acoustics It Is Often Possible to Eliminate Echos

By H. H. Sheldon, Ph.D.

Chairman of the Department of Physics, Washington Square College, New York University

STICK your head into an empty barrel and talk in a loud voice. How much of what you say do you suppose will be understood by an auditor near by? Stand on the platform of an empty auditorium or concert hall and talk to a single auditor in the rear, on some subject unfamiliar to him. How many of your words will he recognize? In some halls he will hear all of them, but generally this will not be the case if the hall is large enough to seat more than a few hundred people.



FINDING THE TIME OF REVERBERATION

FIGURE 1: *These curves show time in seconds against the cube root of the volume in cubic feet. From them the proper time of reverberation can be found. Upper, "no audience"; center, one-third audience; lower, full house*

Why do we build our auditoriums like empty barrels, to pick up, reverberate, re-echo, and distort the sounds produced in them? Because few of us take the trouble to learn the simple fundamental principles governing the construction of halls of correct acoustical properties, or the methods of correcting those already constructed.

If one could say, "mix two cups of sugar with six of butter, to this add vinegar to taste, stir well before using and bake in a slow oven," that would simplify the whole matter and halls would be well designed from then on. Each auditorium, however, is a new research problem and must be treated as such. Now a research problem requires three things of the individual undertaking it—first—a certain amount of brains (which most of us have); second—the ability to think for oneself (which few people care to trouble themselves to do); and third—ingenuity, which I believe to be an inherited trait. Those who have these qualifications are now going to be let in on something. The trouble with the barrel to which reference was just made was "reverberation." Get back upon the stage again—shout, drop a timber, or something of that sort, and you will hear reverberation for one or two seconds, even in a small hall of good acoustical properties, and maybe for five seconds or more in a large hall of poor quality. A certain amount of this reverberation is necessary. Otherwise the hall would sound "dead" and when an audience was present the sound would not "build up"; near the back of the hall hearing would be poor.

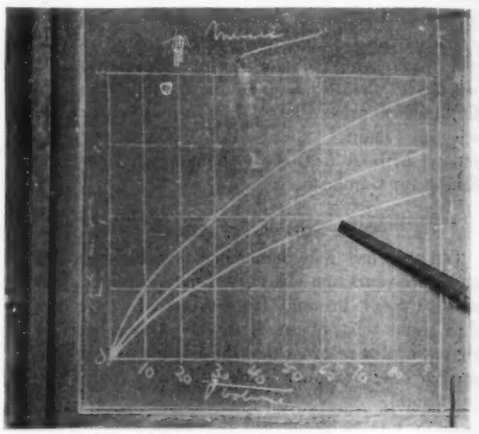
Just how much reverberation is desirable has been determined by extensive research, and is shown by Figures 1 and 2 which are taken from "Acoustics of Buildings" by F. R. Watson and are deduced from the mathematical theory of reverberation. More reverberation is allowable in halls used for music than in those used for speaking. The carrying of one note over into the next is somewhat desirable, but the carrying of one syllable over into the next is confusing. It is seen from the curves that the size of the hall is important when reverberation is being considered.

The Danger of Echoes

Now the question comes, "Suppose we wish to build a new hall, can we determine beforehand the amount of reverberation which it will have? After the hall is built, it will do us little good to discover that sounds persist longer than they should. Can we, however, correct it even then?"

Thanks to the excellent work of the late Prof. Wallace C. Sabine the answer to both questions is yes. Prof. Sabine developed a formula giving the time of reverberation most suitable for any hall. This formula was $t = \frac{.05\ V}{a}$, where t is the time in seconds, V is the volume of the hall and "a" is the absorption coefficient. The latter differs for different materials. The factor "a" can be determined from the table given in Figure 3 (from "Acoustics of Buildings"). The number of square feet of each kind of material in the building is taken separately, is multiplied by its factor and the results for each are added together, giving the final value of "a."

The following example is taken from the book already referred to. The hall to be used for music had a volume of 231,000 cubic feet. Taking the cube-root of this number, 61.4, and referring to Figure 2 it is seen that 2.4 seconds is, on the average, the proper time for reverberation to persist in this case. According to this, then, the value for "a" should be 4812 units (Figure 4). Computed from Figure 3 it is actually as follows:



CURVES FOR SPEAKING AND MUSIC

FIGURE 2: *This gives the conditions for best results when the hall is to be used for speaking as well as for music. Less reverberation is allowable in halls that are used for speaking than in those that are used only for music*

Plaster	— 23,300 sq. ft. at	.025	=	582 units
Wood	— 15,448 sq. ft. at	.061	=	942 "
Vents	— 455 sq. ft. at	1.00	=	455 "
Glass	— 616 sq. ft. at	.025	=	15 "
Upholstered seats	— 1.042 sq. ft. at	1.5	=	1563 "
				3557 "
Audience — 350 at	(4.7 — seat at 1.5 = 3.2)		=	1120 "
				4677 "
Audience 1.042 at	(4.7 — 3.2)		=	3340 "
		(3340 + 3557)	=	6897 "

The time of reverberation for no audience was = $t = .05 \times 231000 \div 3557 = 3.25$ seconds; for 1/3 audience $t = .05 \times 231000 \div 4677 = 2.47$ seconds; and for full audience $t = .05 \times 231000 \div 6897 = 1.67$ seconds. Such a hall would be very

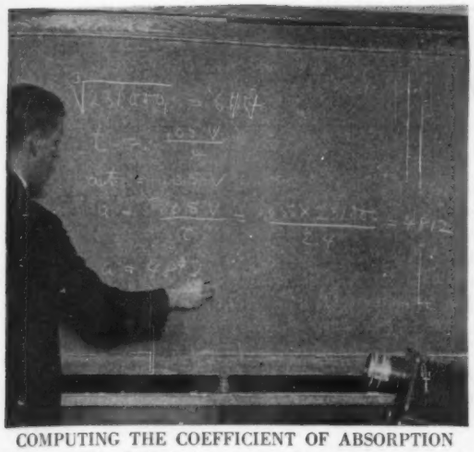
Sound Absorption Coefficients

Akoustolith (artificial stone)	per square foot	.36
Brick wall, 18 in. thick	" " "	.032
Brick wall, painted	" " "	.017
Brick, set in Portland Cement	" " "	.025
Carpets, unlined	" " "	.15
Carpets, lined	" " "	.20
Carpets, heavy with lining	" " "	.25
Carpet rugs	" " "	.20
Celotex, ½ in. thick	" " "	.31
Cheesecloth	" " "	.019
Cocoa matting, lined	" " "	.17
Concrete	" " "	.015
Cork tile	" " "	.03
Cretonne cloth	" " "	.15
Curtains, chenille	" " "	.23
Curtains, in heavy folds	" " "	.5 to 1.0
Flax, 1 in. thick, with unpainted membrane	" " "	.55
Glass, single thickness	" " "	.027
Hairfelt, 1 in. thick, with unpainted membrane	per square foot	.55
Hairfelt, 1 in. thick, with painted membrane	" " "	.25 to .45
Hairfelt, 2 in. thick, with unpainted membrane	" " "	.70
Hairfelt, 2 in. thick, with painted membrane	" " "	.40 to .60
Insulite, ½ in. thick	" " "	.31
Linoleum	" " "	.03
Marble	" " "	.01
Oil paintings including frames	" " "	.28
Open window	" " "	1.00
Oriental rugs, extra heavy	" " "	.29
Plaster on wood lath	" " "	.034
Plaster on wire lath	" " "	.033
Plaster on tile	" " "	.025
Stage opening, depending on stage furnishing	" " "	.25 to .40
Varnished wood	per square foot	.06
Ventilators (50 percent open space)	" " "	.50
Wood sheathing	" " "	.061
Wood, varnished	" " "	.03

Individual Objects

Audience	per person	4.7
Church pews	per seat	.2
House plants, per cu. ft.	" "	.0031
Seats, upholstered, depending on material and lining	" "	1.0 to 2.5
Seat cushions, cotton covered with corduroy	" "	2.16
Seat cushions, hair covered with light damask and canvas	" "	2.27
Settees, upholstered in hair and leather, seat and back	" "	3.
Wood seats, for auditoriums	" "	.100

FIGURE 3: *Each of the substances commonly used in halls has its own coefficient of sound absorption. Those given in this table relate to the formula given in the text*



COMPUTING THE COEFFICIENT OF ABSORPTION

FIGURE 4: *How Sabine's formula may be used to compute the most desirable value for the coefficient of absorption*

satisfactory so far as reverberation is concerned.

If the hall is still to be built, the materials can all be determined beforehand. If it is already built it can be corrected by adding panels of suitable material to the walls in order to make the necessary change in reverberation, or by using false walls of lattice work out from the main wall.

If we stand at some distance from a smooth cliff or a relatively flat-surfaced building and shout "echo," then, as the poets say, "Echo answers 'Echo.'" Actually, as youngsters we were more likely to shout "You old fool," and so on. But as investigators our interest is in the distance at which we must stand from the wall and in what happens at the wall. Ground glass will not reflect a beam of light because it has roughnesses comparable in size to the wavelength of the light, while a smooth mirror will reflect such a beam. So with the cliff and the sound wave which strikes it. (Figure 5.)

Second, an echo is not distinguishable as such if it strikes the ear less than one-sixteenth of a second after the original sound. Since this is a rather rough measurement, and allowing for difference in individuals, it means that sound can travel about 75 feet in this interval of time. Therefore, in order to hear an echo one must stand not less than 35 feet from the wall, so that the distance the sound travels to the wall and back will be 70 feet or more.

Therefore, in an auditorium with a speaker on the platform we shall not hear an echo unless the sound reaches us by two paths which differ in length by 75 feet or more. This rules out small auditoriums, differences in path as large as this are there out of the question. In larger auditoriums it may happen quite readily, due to reflections from the walls and ceilings. This is especially true where smooth, curved surfaces are used.

The reflection of sound can be illustrated by means of two parabolic reflectors (Figure 6). By using these the ticking of a watch can be distinctly heard over considerable distances.

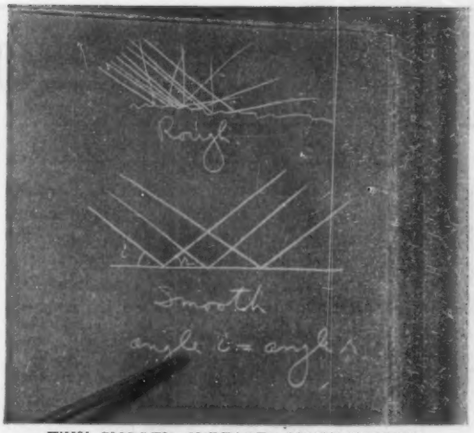
In a rectangular hall of any size, echoes are extremely unlikely because the reflected sound shows no tendency toward concentration. Instead, it spreads out, giving a reverberation. It is only when curves, of which architects are so fond, are employed that real danger of echoes exists. A circular amphitheatre, with domed roof, smooth plastered (a style not uncommon), is wonderful in respect to its echoing possibilities. Figure 7 shows cross sections with possible echo regions. For the sake of simplicity, these illustrations have been only slightly more exaggerated than some that have been observed.

In correcting an auditorium for echoes it is necessary to find the places in the hall where they are troublesome. This can be done by taking up each curved surface separately and applying the well-known law of reflection—that a reflected ray makes the same angle with the surface that the incident ray makes. If you think of a line as being drawn from the speaker to a spot on the wall, then the observer should be so stationed that a line from him to the same spot slants away from the wall by the same angle as that from the speaker to the wall. If the distance from the speaker to the spot and to the observer is greater than the direct route, that is, speaker to observer, by more than 75 feet, and if the wall is curved or arched, an echo is likely to be heard more or less distinctly, depending upon the curvature and material of the wall.

More Research Is Needed

One exact way of testing for echoes is to place a watch at the focus of a concave reflector, for example, in place of the bulb of a spot-light having the glass removed, or at the focus of the reflector of an electric heater. Place this on the stage in the position of the speaker and turn it toward the suspected portion of the wall. Locate your position according to the law of reflection. If an echo exists, the watch can be heard clearly, if the hall is quiet.

Another and a more satisfactory way is to place at the focus of such a reflector a carbon arc, such as is used in an ordinary stereopticon or projection lantern, and to light it with alternating current instead of direct. The reflector is turned so that the light strikes a mirror held flat on the suspected wall and the echo of the hum produced by the alternating current arc is sought at the place to which the mirror reflects the light. This eliminates most of the guess work. The same procedure may be used by reflecting the light from a spot-light and finding where it goes, then replacing the bulb with the watch as before.



WHY SMOOTH SURFACES MAKE ECHOES

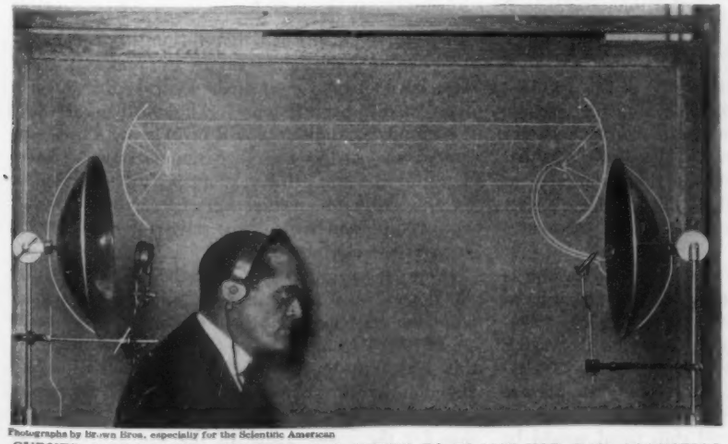
FIGURE 5: *Rough surfaces reflect sound in all directions. From smooth ones it follows the law shown in the figure*

When it has been established that any portion of wall surface is responsible for echoes, the correction lies in covering it with sound absorbing material or in roughening it, if possible, so as to break up the echoes. For example, it may be coffered or latticed to harmonize with the architectural scheme.

The question of the proper size for a hall is one upon which little reserch has been done. Obviously, a military band would not sound well in a drawing room, nor could a single speaker be properly heard in a stadium. But there are finer shades of distinction than this to be drawn. Fortunately the ear helps out in this regard, for actually a dozen instruments do not sound twelve times as loud as one, but only two or three times as loud. Thus considerable latitude is allowable in any hall.

There is obviously some best size, however, for an auditorium to accommodate an orchestra of any particular number of pieces. This size should be just as possible to determine as is the best time of reverberation, and would depend upon the number of brasses, strings, wood-winds present.

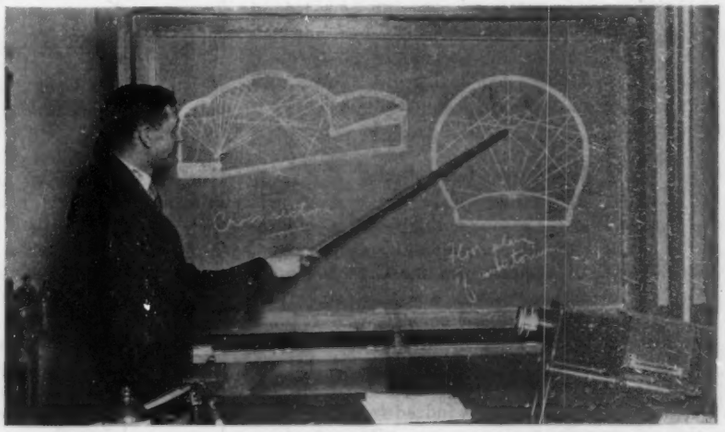
A considerable amount of useful research remains to be done in this study of acoustics, and the author hopes that those who are interested in obtaining further information for its own sake, or for application in designing or correcting halls in which they are interested, will feel free to communicate with him. Of particular interest will be inquiries from those who wish to make a systematic study of this subject with a view to becoming specialists, and from those who wish to aid in research to add to the meagre knowledge which we now have of it.



Photographs by Brown Bros. especially for the Scientific American

CURVED WALLS AND CEILINGS ARE OFTEN TO BLAME FOR BAD ACOUSTICS

FIGURE 6: *The ticking of a watch can be heard over long distances by using parabolic reflectors. The path of the reflected sound waves is shown on the blackboard*



WHAT OFTEN HAPPENS WHEN THE WALLS ARE CURVED

FIGURE 7: *Auditoriums are frequently built with cross-sections, vertical and horizontal, similar to those shown here. The distinctive results which may follow are made clear by the sketch*

Our Point of View

The True Pioneers of Industry

MOST earnestly do we commend to the attention of the public of America, and particularly of those who control the vast industrial interests of the country, the protest of Secretary Hoover against our failure to make adequate provision for research in the realms of pure science.

Without its Lewis and Clark, its Daniel Boones, its Kit Carsons, its covered wagons and the undaunted hearts of the men that manned them, the America that we know today would have remained a shadowy dream of the comfortably housed and stay-at-home visionary.

The man with the test tube and the microscope is the pioneer of the vast, unexplored fields of pure science. When he stops, progress stops. All the wealth of all the oil kings, sugar barons, railroad magnates and multitudinous millionaires of our boasted civilization could not buy its way into those unknown lands unless the pure science pioneer blazed the way.

In the past, thanks to our richly endowed universities, industry through these institutions has been well supplied with modern representatives of the great prototype, Sir Isaac Newton. But the captain of industry has gathered in these gentlemen and set them to the special task of applied science research in the one limited field covered by his particular industry; so that, today, for one investigator devoted to the detached field of pure science, there are ten at work in the special and limited fields of applied science in steel, textiles, chemical products, oil, and so forth.

Never was a more timely warning uttered than that of Mr. Hoover when, in characteristically forceful phrases, he called the nation's attention to our steadily-diminishing efforts in pure science investigation. We recently referred, and we refer again, to the statement of Dr. Robert A. Millikan, when he said, "Subtract the idea that was born with the formulation of Newton's law of motion from modern civilization, and that civilization collapses like a house of cards, and mankind reverts at once to the mode of life existing in ancient times."

It is the aim of Secretary Hoover and the National Academy of Science which will administer the fund, to secure the sum of $20,000,000—the interest on which will be devoted entirely to pure science research. Three million dollars of this sum has already been obtained, and if the business interests of the country realize that we are lagging behind the rest of the world in this field of effort, and that our industrial supremacy, because of this neglect, is being seriously threatened, there will be no difficulty in securing the full sum, great though it may seem to be.

An Impossible Canal

"POLITICS makes strange bedfellows"; as witness the present scramble of our politicians to tuck themselves in under the blankets alongside the proposed $600,000,000 ship canal from the Great Lakes to New York.

The civil engineers of the country, who have an inborn love for solid facts, straight thinking and truthful statement, have long ago decided that the idea of cutting a deep sea or ship canal through the heart of New York state, judged from the standpoint of economics, is an impossible phantasy. Judged as a mere feat of construction, the thing can be done, although when the big ditch was dug, it would prove to be a serious question as to where the water could be obtained to maintain the canal throughout its upper levels.

Any qualified and unbiased economist will tell you that the prospects of obtaining adequate returns on a canal through New York state, which will be eight times as long as the Panama Canal and will cost 50 percent more than that most costly undertaking, is extremely remote. Furthermore, 30 feet is the minimum useful depth for any ship canal. The Suez Canal has been deepened to 30 and 35 feet, and our own Panama Canal carries 40 feet throughout and 45 feet as a maximum. By the time any canal, whether down the St. Lawrence or across New York state is completed, there will be an insistent call for 30 feet as the minimum serviceable depth, if sea-going ships are to sail from deep water to the various ports on the Great Lakes. By that time, means will have been found permanently to raise the lake levels, and the leading lake seaports will have deepened their channels and waterways to 30 feet.

These Great Lake improvements are as certain as the daily rising of the sun, and if politicians succeed in burdening the federal government with this $600,000,000 venture, the country will find itself carrying the load of a great engineering work that is altogether inadequate for its purpose. The present barge canal is a white elephant, and changing the barge canal into the proposed ship canal would be merely to exchange one white elephant for a larger one.

It is a favorite trick of the politicians, when they are trying to boost some scheme which they know cannot stand on its own merits, to drape it with the American flag and cry aloud from the housetops that the thing must be done at the particular place and in the particular way proposed, because, it will be an "all-American" venture and is "absolutely necessary for the purpose of national defense." There are occasions when this appeal to the patriotic instincts of the people is perfectly proper and eminently helpful, but the present outburst of propaganda for the construction of the ship canal is not one of these.

Give "Old Ironsides" a Suit of Sails

It is gratifying to learn that the response of the school children of the country to the appeal for funds to rebuild *Old Ironsides* has been so generous that the required fund of $500,000 will undoubtedly be raised. So great is the interest in this famous ship, that the fund could have been secured quite readily from people of means throughout the nation, but Admiral Andrews, the Commandant at the Boston Navy Yard, and those associated with him in this enterprise, wished to make the reconstruction of this historic ship the means of awakening deep interest among the school children of the country in the glorious early history of the United States Navy.

We venture to make the suggestion that when this splendid frigate is once more afloat in all the beauty and majesty of her towering masts and huge spars, it would be well worth while to fit her out with a complete suit of sails and use the vessel for training either our midshipmen or our embryo naval reserve officers in seamanship. Let the renovated *Constitution* be maintained as a regular commissioned unit of our navy, and let her cruise in the summer season from port to port, and at times sail across the western ocean to show Old Glory in the foreign ports, where she flew her flag when she was making history and winning respect for the youthful republic of the western world.

Lakehurst Station Will Be Maintained

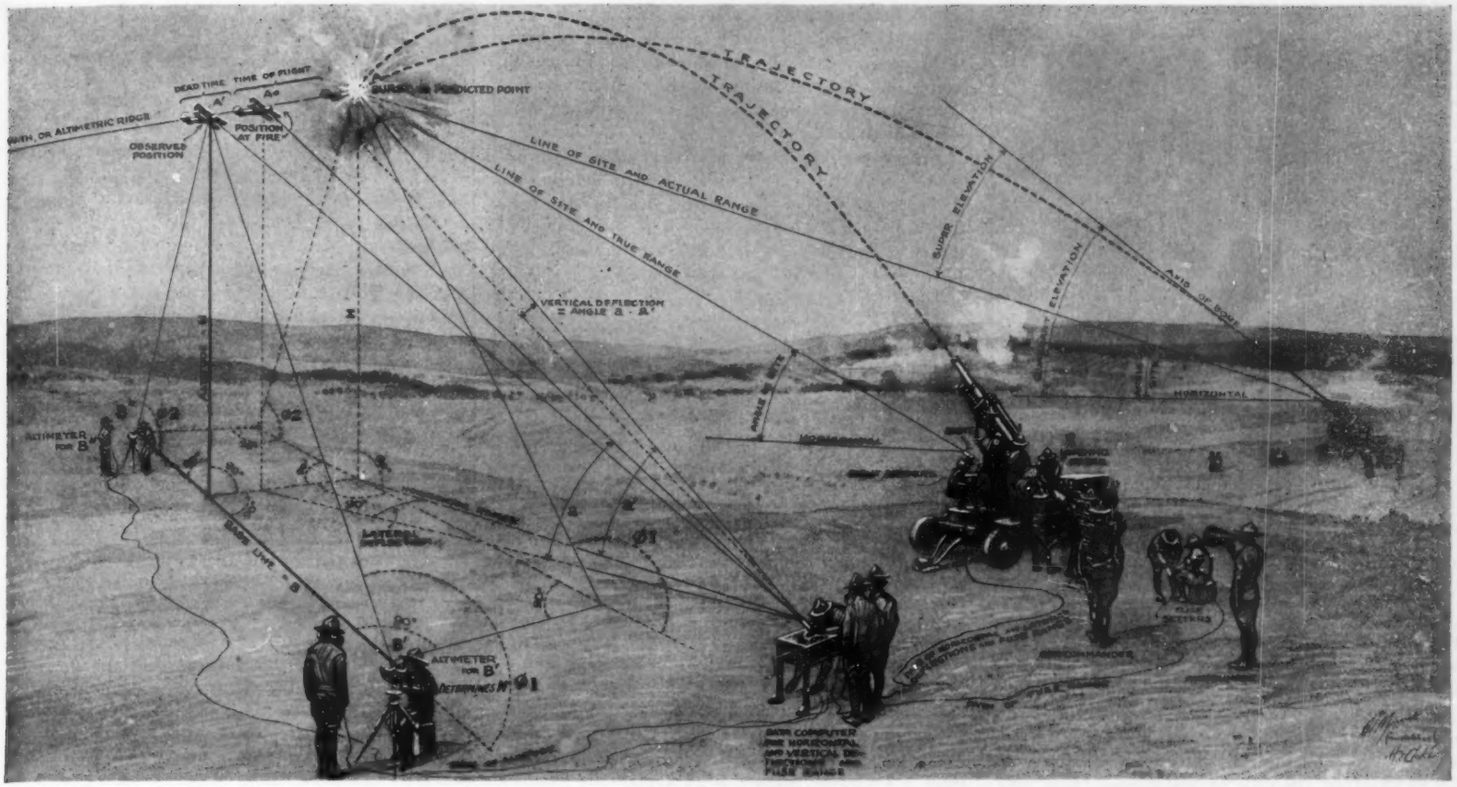
IN our issue of March, 1926, on page 156, in commenting upon the House Naval Bill, we stated that the discussion of the bill had revealed a sharp division of opinion among the ranking officers of the navy, particularly as to the future policy in regard to the construction of dirigibles. We stated that Secretary Wilbur and Rear-Admiral Jones were opposed to the construction of a new dirigible to take the place of the *Shenandoah;* that they were in favor of closing down the activities of the Naval Station at Lakehurst, New Jersey, and recommended that the sum appropriated for the maintenance of that station be reduced from $1,880,000 to $130,000.

We are now in receipt of a letter from the Navy Department which states it is evident that through some error, the writer of this article has misunderstood the attitude of Secretary Wilbur and Rear-Admiral Jones, and that it is hoped that we shall be able to correct this error in the near future. We hasten to make this correction, and it is as gratifying to us as it will be to all who are interested in lighter-than-air navigation, to learn that both of these gentlemen are in favor of maintaining the Lakehurst Station in operation, and favor, moreover, the construction of a dirigible, over twice the size of the *Shenandoah,* to take the place of that ill-fated ship.

We are the more glad of the opportunity to make this correction because we realize, as perhaps the Navy Department does not, how widespread was the impression that Secretary Wilbur and his ranking officers were so discouraged by the smash-up of the *Shenandoah* that they were in favor of abandoning further lighter-than-air aeronautical work. This was the universal impression in our office, and so far as the writer's experience goes, it was the impression of the general public.

We are now satisfied that this misunderstanding arose from an over-emphasis by the public press of that clause of the report of the General Board which deprecated appropriations for lighter-than-air work, if such appropriations would involve the sacrifice of any of the surface-ship programme now in hand. We think the Navy Department is fully justified in its desire not to sacrifice surface ships of a well-approved type in favor of the relatively experimental ships of the air.

From the printed record of the hearings before the House Naval Committee, we quote the following from the Secretary's testimony which can be taken as settling definitely the Secretary's attitude on this important question: "We are not willing to abandon the work of the *Los Angeles,* but we recommend that Congress make the necessary appropriation for the maintenance of the *Los Angeles,* and Lakehurst as incidental to the maintenance of the *Los Angeles.*"



MECHANICAL MATHEMATICS

Worked out by most ingenious instruments, furnish the complicated calculations necessary in modern anti-aircraft firing

Is Anti-aircraft Artillery Overtaking the Airplane?

An Answer to Those Who Fear the Danger of Invasion from the Air

By Colonel H. E. Cloke

Coast Artillery Corps, United States Army

CONSIDERABLE thunder has recently been in evidence on the question of national security against invasion from the air, so it is well that the public be acquainted with the exact facts of the case as they exist today.

There is a general belief among people at large that anti-aircraft guns fire at airplanes in the same manner as a hunter does with a shotgun when shooting ducks. This is not literally true, although in a certain sense the principle of "leading" ahead of the duck or plane is the same. The anti-aircraft gunner, however, does not "guess" on the "lead," but works out the amount mathematically.

Anti-aircraft artillery, which is now a branch of our Coast Artillery Corps, was first used in the World War, although two pilot mounts had been constructed by the French prior to 1914. No fire control whatever was in use.

The first guns used against airplanes were French 75 mm's. These were placed in gun pits or on platforms with their trails or wheels so arranged that the guns could be given greater elevation than is ordinarily possible on level ground. Eventually, a type was especially designed for high-angle fire. The methods of firing it were somewhat similar to the usual field artillery methods for land fire. It was found, however, that these methods were not applicable to the anti-aircraft gun problem, so new schemes of fire control and the design of automatic machines and apparatus for obtaining the basic elements of firing data had to be evolved. Eventually, a method of "predicting" a future position of the target or plane was conceived, such that when the guns had their sights set for this "predicted position" and were fired, the target and the projectiles met—theoretically.

This system of fire control has been worked out by experience in war as well as in tests, and in thousands of trials at our proving grounds. After trying all the various schemes presented or conceived, our country has gradually accepted the "angular travel method" as the best system so far designed. This system as well as the "linear speed method" makes the altitude of the target the basic element. It is dependent upon three assumptions. These assumptions are that the plane will travel in a straight line, at a constant speed and uniform altitude. It would, of course, be best to avoid any assumptions, but with a target such as an airplane, the problem is entirely different from that of a ship at sea. These three assumptions are to hold only during the period of time included in the time it takes to load the gun and the time of flight of the projectile.

"Predicted Position" Based on Mathematics

The loading or "dead time" is taken as eight seconds. This includes determining the fuse range. The time of flight varies with the altitude or height of the plane above the ground and the horizontal distance it is from the gun. With our present 1918-model, three-inch gun, it is almost nine seconds at 12,000 feet when directly overheard. At 7,000 yards range for the same height (12,000 feet) it is about 24 seconds.

If this total time (dead time and time of flight) be large, the plane can change any one of the above assumptions and avoid being hit, but if this time be reduced to a few seconds, the situation for the aviator becomes decidedly dangerous, especially if he be a heavy bomber without power to change these salient factors quickly. Then again, the first burst of shells is the one which really "tells the story," for, it is understood that a squadron of heavy bombing planes (and these are the principal type with which we are primarily concerned) flies in formation as do ships at sea, with these three factors of speed, direction and height practically constant.

Our Ordnance Department has already produced an automatic 37-mm. gun with a high muzzle velocity (3,000 foot-seconds) which gives a flat trajectory or almost straight line path of projectile and a very short time of flight. Its maximum range is about 14,000 feet. This gun fires a shell weighing 1¼ pounds to a height of 14,000 feet, and has a horizontal range of almost 8,000 yards. Its rate is 120 shots per minute. The maximum ceiling expected from the latest types of bombers is about 15,000 feet. Also, a tracer has been successfully developed which has powder composition at the base of the shell and burns with a bright light while the projectile is in the air, as does a skyrocket. This permits an observer to see each bullet or projectile as a skyrocket effect throughout its entire flight. In addition, a fuse has been produced which is supersensitive and at the same time safe to handle. *It will explode the shell on contact with airplane fabric.* Furthermore, we are developing an automatic appa-

WIND AND PARALLAX COMPUTER

This instrument determines the deflections due to wind. These values are set on the data computer

ratus which will reduce the "dead time." We are striving to reduce the "dead time" and the time of flight and to increase the initial velocity of the gun.

This "predicted position" of the target is based upon good sound mathematics and is computed to the nicest degree of accuracy. To explain this clearly, let us illustrate the case of any cannon, gun, rifle, or shotgun. To shoot a running deer, we must aim our rifle *ahead* of the deer and at the distance *to* the deer. Or, in order to hit a "predicted" position of the deer as determined by experience or the hunter's trained eye, the sight must be set for the range and the rifle *lead*.

The heavy cannoneer does the same thing as a deer hunter, only he does it mathematically. He plots the position of his target on a map or plotting board, predicts a position ahead of the course of the ship or target, finds its range or distance in yards, and its azimuth (direction from north and south line) in degrees, then aims the gun at this range and at this angle. When the time of fire, or position, or target at its predicted position, less the time of flight, arrives (determined by a clock) the gun is fired and *theoretically* the ship or target must meet. This may be readily accomplished in heavy artillery fire directed at a ship at sea, for a ship moves on a two-dimensional surface. But how does the anti-aircraft gunner account for the third dimension called "altitude?"

Here is the crux of the whole situation. Altitude is the essential and the basic element in determining the necessary firing data which gives us the "predicted position" we are after. It is the altitude of the target which we must determine. A mechanical instrument called the altimeter, does this for us.

There are many different forms of altimeters in use today. Their construction is constantly changing toward simplicity and rapidity of operation. The one shown herewith is our present standard, although the tendency of the times is to design a self-contained instrument based either upon the coincidence, or the stereoscopic principle. Such an instrument would avoid the use of a base line, the use of two instruments, telephones, and so on, and would materially reduce the dead time.

The "angular travel" method is the standard present day fire control plan for determining the "predicted position" of aircraft as targets.

A Foolproof Mechanism

A sight is mounted on the gun carriage and is geared to it and to the gun. This appears to be a very complicated piece of mechanism for a soldier to manipulate, but it is so designed as to be positively fool proof. A rule or a method is all the sight operator or gunner need know. He may be entirely ignorant of all the mathematics upon which the instrument depends for its construction. His orders are to "set the sight for deflection" (the angular travel vertically and laterally during the dead time and time of flight of the projectile) and then to follow the target with the telescope on the sight. The gunners who operate the hand wheels on the gun carriage and gun have their instructions to turn these wheels so as to "follow the pointers" which are on the sight and which are continually moving as the gun pointer or man operating the sight follows the target with his telescope.

The men doing the loading and firing operate independently and fire whenever the gun is loaded, since with the automatic 37-mm. gun, the gun is constantly kept on the target.

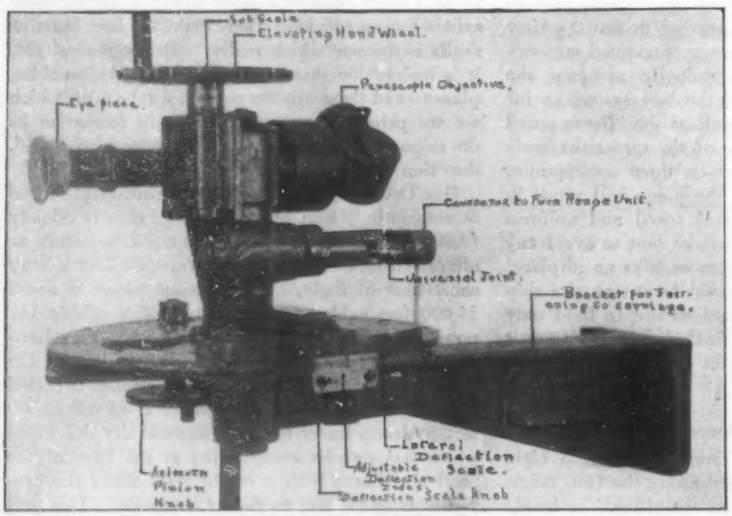
ALTIMETER ON TRIPOD

There are two altimeters used to determine the altitude, one at each end of a determined base line

But what data must this sight setter or gun pointer have before he sets this vertical deflection? Naturally, the angle at which his telescope points when the cross hairs are on the plane, gives him the angle of sight automatically. It should also be understood that the extra or "super elevation" over and above this sight angle or height angle of the plane automatically sets the gun's elevation at its correct amount by a very ingenious combination of levers, cams and gears. "Super elevation" is due to the trajectory itself. The angular height or angle of sight may be 52 degrees and the super elevation six degrees. The total quadrant elevation for the gun would therefore be 58 degrees, at which it must be elevated.

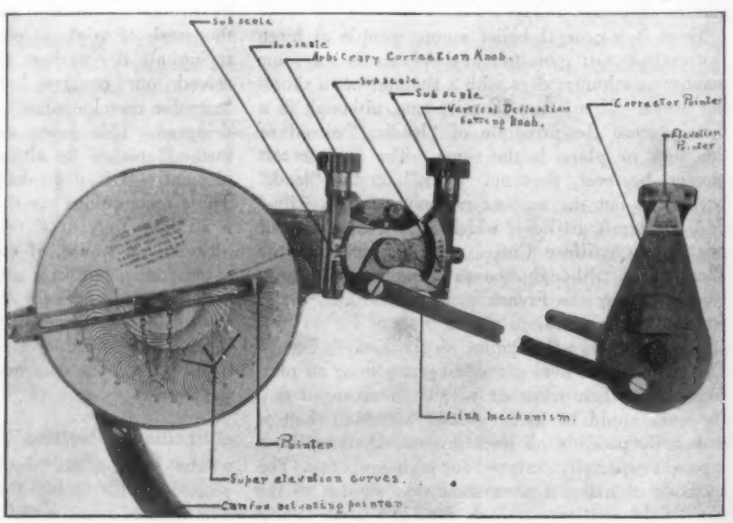
The essential elements of anti-aircraft fire then are: 1: Vertical deflection. 2: Lateral deflection. 3: Fuse range.

The instrument that has been designed and constructed for determining these elements is called "The Anti-Aircraft Data Computer Model 1917." It is mechanical in its construction and automatic in practically all of its functions. It determines mechanically these three elements of firing data.



ANTI-AIRCRAFT SIGHT

This sight is on the left of the gun. It is connected to the elevation sight called the fuse range unit, on the right of the gun. It is operated as follows: (1) Gunner sets sight on target by operating the "Azimuth Pinion Knob" and the "Elevating Hand Wheel." (2) Another gunner sets the lateral deflection obtained from the data computer on the lateral deflection scale, by operating the knob. (3) Another man keeps the two pointers on the lateral deflection scales in coincidence by turning the gears on the gun until these pointers meet. Thus is the gun kept constantly on the target at the "predicted direction"



THE FUSE RANGE DISC

This part of the sight is on the right of the gun. The elevation pointer is connected directly to the sight on the left. As the sight on the left elevates, this pointer moves. As the gun is elevated the corrector pointer moves with it. The vertical deflection and the fuse range are obtained from the data computer and set on the vertical deflection scale and the fuse range disc. The operation from then on is for the gunner at the elevating mechanism to keep the elevation pointer and the corrector pointer in coincidence. This keeps the gun constantly at the "predicted elevation" coincident with the "predicted direction"

The altitude of the target is the only data necessary to feed it, in order to produce these elements of fire. It is oriented in azimuth in a way similar to an ordinary transit. Thus, the gun is kept constantly set at the "predicted point." The ammunition detail loads and fires as fast as human hands permit, using the "fuse range," as given them by the "data computer," to set the fuses for the time of burst. Thus we have in a nut-shell the basic idea of anti-aircraft fire.

This "data computer" was originally designed by M. Rontin. The 1920 data computer produced in this country is electrical in principle and produces the total vertical and lateral deflections, including wind and parallax corrections.

The past records of anti-aircraft fire have been misquoted in the press of the country many times. In fact, the actual inside history of anti-aircraft fire has been misunderstood, and in some cases it has been considered so ineffective as to be useless.

The following tables are self-explanatory:

Year	Planes brought down	Shots fired per plane	Country	Rate
1916	60	11,000	French	.....
1917	120	No record	French	.....
1918	220	7,500	French	.....
1918½	No data	....	British	One plane for every 4,550 shots
1918½	No data	....	British	One plane for every 1,500 shots
1918½	No data	....	American	One plane for every 605 shots

Results for the entire war:

Nation	Planes dropped by aviation service, all fronts	Planes dropped by anti-aircraft fire	
Italy	540	129	
Germany	6,554	1,520	
France	2,000	500	
America	Not obtainable	58	(17 with 75 mm. guns) (41 with M. G.)
Total	9,095	2,207	

The American service was in action but a very short time toward the end.

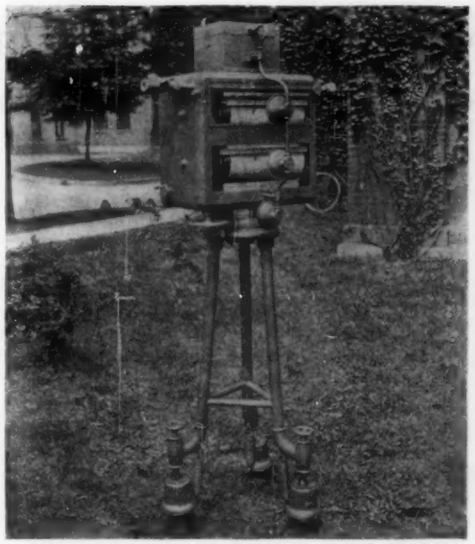
In Hawaii, 1925, target practice, an average of two hits per gun, per minute was made.

Rapidly Gaining on the Airplane

At Fort Tilden, 1925, the following are the official results:

Number of shots fired.....	4,343
Number of hits.....	203
Hits per try, per minute.....	2.03

Or, one hit for each 22 shots fired; or one hit every 29 seconds.



THE STANDARD CORRECTOR, U. S. ARMY TYPE

This is one of the latest instruments for automatically determining the deflections. It is mechanical in its operation and determines the lateral and vertical "lead" or deflection. It has two telescopes, each operated by a gunner who keeps the cross wires of the telescopes constantly on the target

The guns and ammunition used in this test were far inferior to those which have recently been designed and tested.

The following table shows the summarized situation:

Year	Nation	Number of shots to drop a plane
1916	French	11,000
1918	French	7,500
1918	British	4,500
At close of war	British	1,500
1925	U. S. Army	22

From these official reports, it is seen that the anti-aircraft artillery is gaining rapidly on the airplane.

It is safe to predict that the future anti-aircraft gun will be practically automatic, and it will have super-sensitive fuses capable of exploding at a set time or on contact even with so thin a target as the wing of an airplane.

The trend of modern ordnance is also in the direction of higher velocities. Increasing the velocity flattens the trajectory or path of the projectile and reduces the time of flight. The main objective will be to hit on the first burst.

These two vital factors in anti-aircraft artillery *must* and will be accomplished, for, unless some entirely new and different and superior system of fire control is devised, the time of flight becomes the weakest spot in the system. The dead time will in the future be reduced to but a second or two. The time of flight will be *materially* reduced.

In the light of last summer's tests and target practices held in various parts of our domains, especially at Fort Tilden and Honolulu, it is also believed that the future will develop an efficient method of correcting anti-aircraft fire by "observation," as is now done in all other forms of artillery fire. In such a case, after laying the guns of an anti-aircraft groupment on an oncoming squadron of high-powered bombing planes by our usual method of "angular travel," we could, after the first volley of shell bursts, "squirt the hose" on them as it were, the "predicting system" continuing to function; but as the hose pours forth its stream of fire, corrections based on observation would be applied from time to time. The stream of projectiles is visible and the time of flight small; the fire incessant and the fuse explodes either on contact or by setting it for the predicted fuse range.

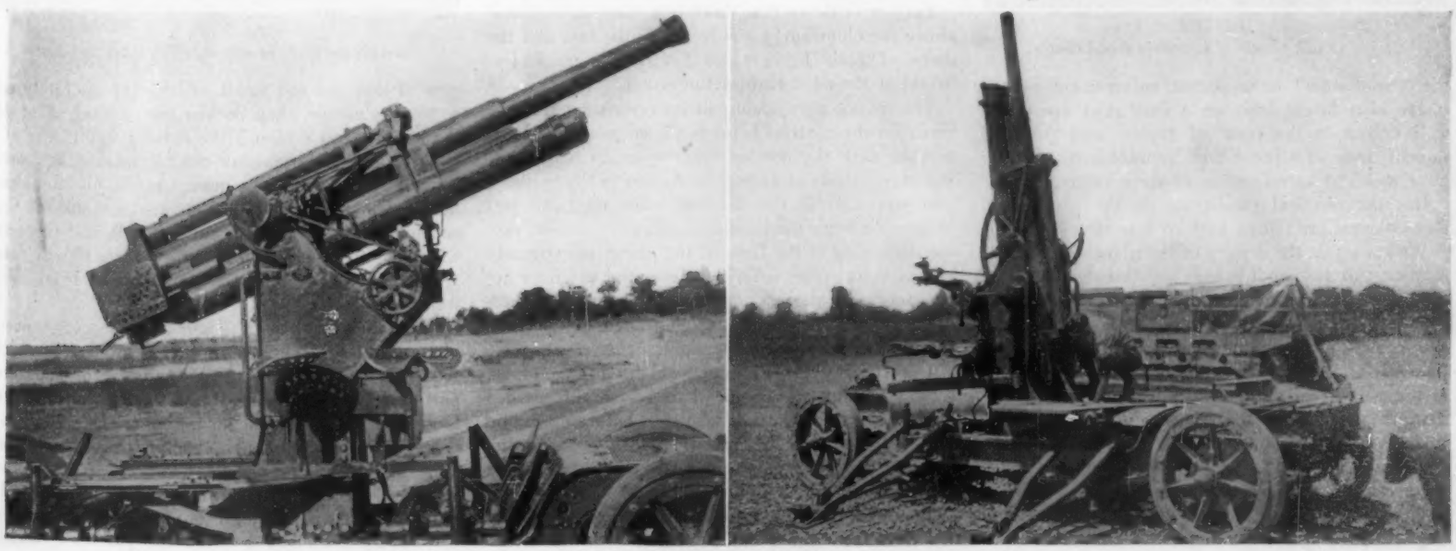
Where there is a will there is a way. And it is the will of our watchdogs of national defense that this weapon be rendered so efficient that air bombers will be in as grave danger when attempting to invade our shore line as would an enemy fleet in attempting to subdue our coast forts.

The Problem a Vital One

It is always the same old story. When machine guns were invented, many people claimed war would be so frightful with this weapon that human beings could not withstand it. Then when the submarine came, some claimed the navy should be all submarines and that all other classes of ships were useless. With every new invention of attack weapon there has always been developed a counter weapon to combat and destroy it. And in the case of the aerial attacker, we will adapt the destroyer, anti-aircraft artillery.

The problem is a serious one, without doubt; it is a vitally important one to the defense and perhaps the very existence of our country; it is also a most difficult one, but that our country will be completely and entirely at the mercy of an enemy with superior air power is firmly disputed.

Predicting upon the curve of the progress which has been made since the World War, it is safe to state that a positive and highly efficient system of anti-aircraft defense will be realized during the coming year.



VARIOUS SIGHT MECHANISMS

Each operated independently, are clearly shown above. The resultant firing position is changed while the gun is being operated, and the moving target can thus be followed with accuracy

The Great Outer Planets

Jupiter and Saturn Have Hot Centers and Frigid Exteriors

By Henry Norris Russell, Ph.D.

Professor of Astronomy, Princeton University. Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

AFTER months of absence, there is once more a planet to be seen in the evening skies. Since Venus passed out of sight in February, only Mercury has been visible in the early hours of the night, and then but for a few weeks and with difficulty. Saturn, which has been a morning star since November, returns to opposition this month, and we shall have at least one planet in the evening sky for the rest of the year.

The great outer planets of our system have been studied telescopically ever since the instrument was invented; yet there remains more to be done in our time, and more is still to be accomplished. Some things, such as the determination of the distances of the planets and the calculation of their motions in their orbits, have been accomplished with such precision that little more remains to be done—until some improvement in our method of observation enables us to make our measurements with greater accuracy.

The distances and motions of the satellites, too, are very accurately known—though of course new and further satellites may at any time be discovered.

The diameters of the planets, though harder to measure with high percentage accuracy (owing to the "irradiation" or apparent enlargement of the image of a bright body on a dark sky) are pretty well known in the cases of Jupiter and Saturn—though those of Uranus and Neptune are uncertain by a much greater fraction of their values.

Brown Brothers

JUPITER

It has a thick mantle of extremely frigid clouds

But the physical conditions on the surfaces of these planets are not so easy to determine fully.

We know that the density of the planets as a whole is low. For Jupiter it is only one-third greater than that of water, and for Saturn only a little more than half of this (71 percent of the density of water). We know, too, from the degree to which the centrifugal force due to the rotation flattens the planets at the poles, that the density must be much greater than the average at the center, and less near the surface. (For a planet of nearly uniform density, the known rates of rotation would produce a much greater bulging at the equator.)

It is certain, therefore, that the outer parts of Jupiter and Saturn, for thousands of miles below their surfaces, must be of very low density—and therefore it seems sure that they are gaseous. Jeffreys has lately calculated that the known facts could be explained by assuming that Jupiter had a solid core—as dense as rock—58,000 miles in diameter, surrounded by an ocean (or a layer of ice) 11,000 miles deep, and this again by an atmosphere of very low density, and 4,000 miles in height. For Saturn the solid core would be 31,000 miles in diameter, the ocean 12,000 miles deep and the atmosphere extend to a height of 8,500 miles.

All that these figures show is that the density of the outer layers must be very low. An actual atmosphere thousands of miles deep would be under such pressure in the lower parts that it would be almost as dense as water, unless it was hot. So that it is probable that the inner parts of Jupiter and Saturn are at a high temperature.

The surfaces of both planets, however, are very cold. Measures of the heat which the planets send us show that almost all of it comes with the reflected sunlight, and very little from the surface itself, and that the temperature of the surface, in both cases, must be at least 120 degrees below zero, on the centigrade scale, and probably lower still. The conspicuous and rapidly changing markings on Jupiter's surface, which have long been recognized as of a cloudy nature, must therefore be due to clouds of some substance which condenses at a far lower temperature than water—and would boil furiously at a hundred degrees below zero.

Conditions We Cannot Duplicate

Above the cloudy surface there is still a good deal of atmosphere, for the spectra of all four of the outer planets show bands in the orange and red, growing increasingly heavier from Jupiter to Neptune. These bands have never been duplicated in the laboratory—perhaps because the thickness of the planets' atmospheres is much greater than any thickness of absorbing gas that has yet been experimentally tested, or perhaps, as Menzel has suggested, because the gaseous constituent which produces the absorption is stable only at very low temperatures and can exist in large quantities only at the very low temperatures of Uranus and Neptune.

Further evidence that there is a dense atmosphere above the cloud-surface is found in the fact that the disks of both Jupiter and Saturn are much less bright at the edge than at the center.

This is not conspicuous in an ordinary telescopic view, for the contrast between the edge of the planet and the dark sky outside exaggerates its brightness. But if one looks at Jupiter or Saturn in the twilight, and especially in the daytime, when they can just be seen through the blue foreground of a clear sky, the darkening at the limb of the planet is extremely conspicuous. The difference from the ordinary appearance on a dark sky is so striking that the observation can be especially recommended to amateurs familiar with the aspect at night.

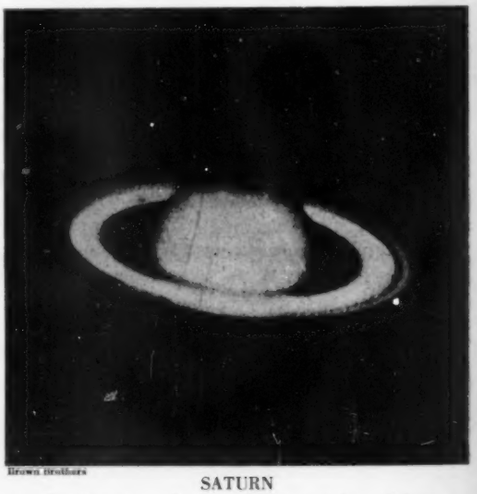
Unfortunately, it is impracticable to find the planet by day without an equatorial telescope with divided circles; but the enthusiast who rises before dawn and watches Jupiter or Saturn when they are morning stars, in the increasing light, will be well repaid for his trouble.

Remarkably enough, practically no measures of the degree to which the brightness falls off at the edge of the disk have been published until very recently; but the matter has just been thoroughly discussed by Schönberg, who observed at Pulkowa and Dorpat, but has published at Helsingfors.

According to his measures, the brightness at the edge of Jupiter's disk is only one-eighth of that at the center. To account for this, it is necessary to assume that about 37 percent of the light is absorbed in passing through the planet's atmosphere. Near the edge of the apparent disk, where the path of the rays through its atmosphere is longer, the effect increases greatly.

Another conclusion of Schönberg's is that after allowance is made for the changing distances from the earth and sun, the brightness of Jupiter falls off about one percent for each degree of the "phase angle"—the angle which the line from Jupiter to the earth makes with that joining Jupiter and the sun.

A similar but much greater effect occurs in the case of the moon, and it can then be attributed with certainty to the fact that one satellite's surface is rough and full of objects, big and little, which cast shadows. When the earth is right between the moon and the sun (just enough out of the way to avoid an eclipse) each mountain or rock hides its own shadow; but if we are even a few degrees out of line, the shadows come into view on one side; and, even if they are too small to be seen separately on a great telescope, they darken the general effect of the surface and diminish the moon's light.



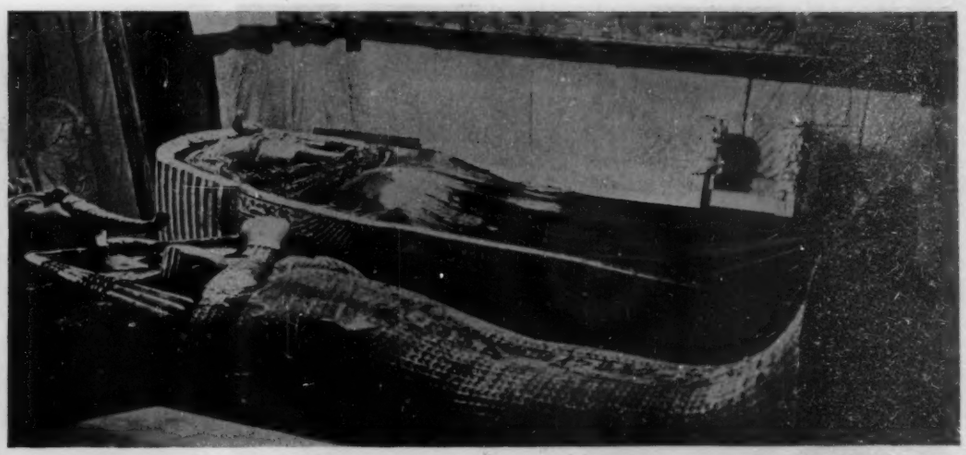
Brown Brothers

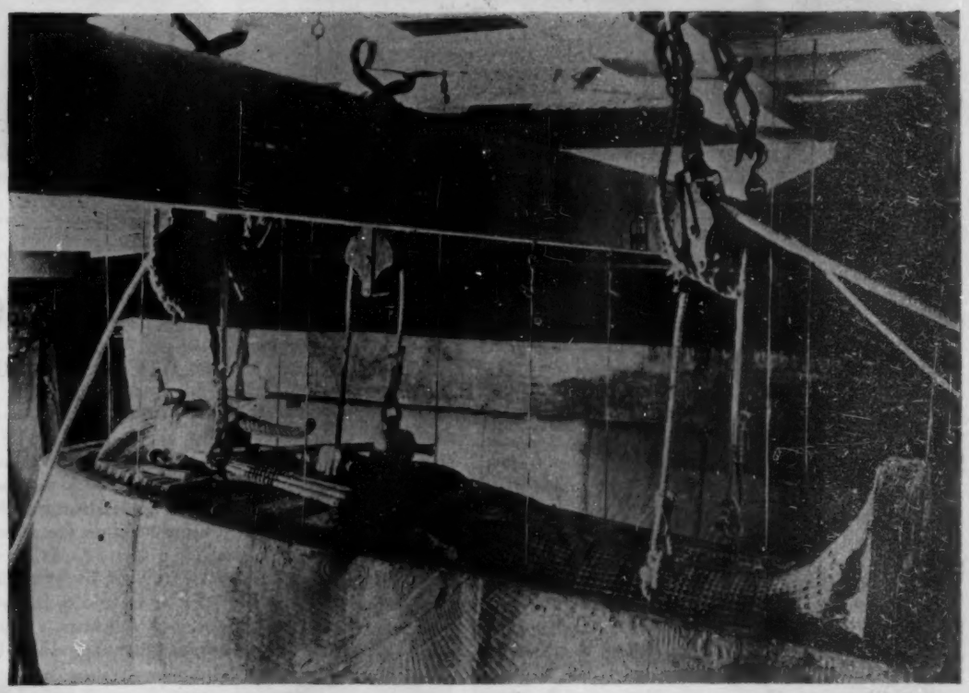
SATURN

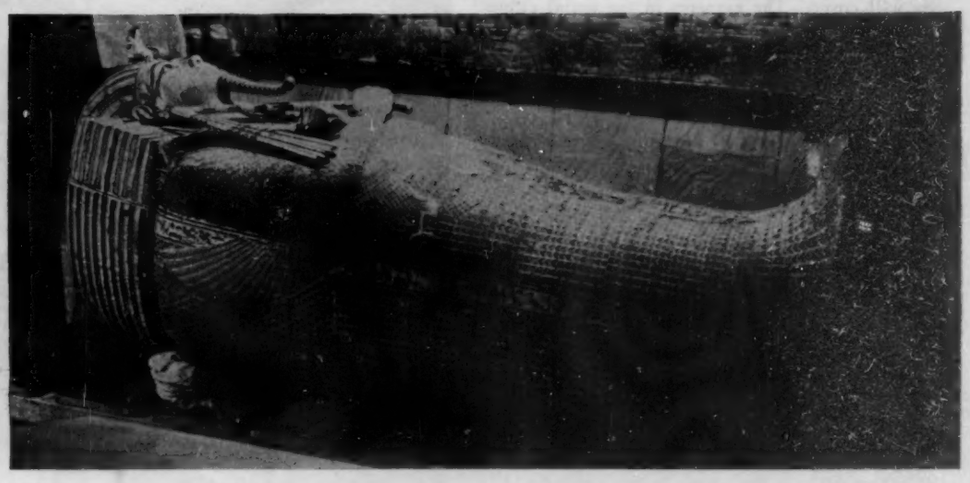
Its rings are made of swarms of particles and dust

On Jupiter, the shadow-casting masses are presumably clouds, like the great cumuli, or "thunderheads" in our own sky. If about one-eighth of the surface was covered with such clouds and the rest with smooth clouds whose upper surface was free from shadow, the observed variation in brightness would be explained.

The rings of Saturn show a very pronounced phase effect—arising, as Seeliger showed years ago, from the fact that they are composed of separate particles, scattered in swarms so extensive that they look from a distance like a continuous sheet. Schönberg, after a careful study, concludes that within the apparently continuous rings, not one percent of the volume is occupied by solid particles, and that, all around these, is a cloud of fine dust—probably formed by collisions between the particles, which accounts for the high reflecting power of the ring.







Photographs from Wide World

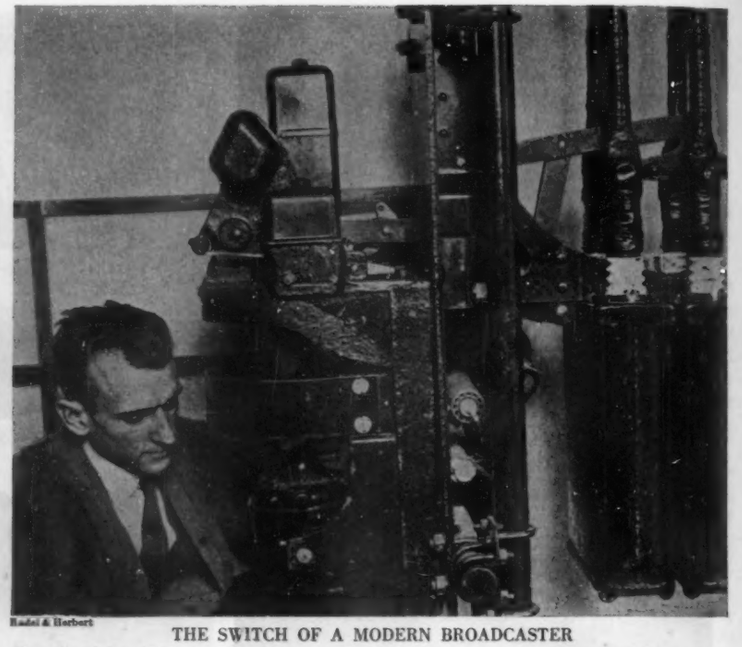
Tut-Ankh-Amen's Golden Coffins, the Work of Ancient Egypt's Most Skilled Artisians

Within the burial chamber hewn from the solid rock, Tut-ankh-amen's mummy was protected by many enclosures of wood, stone and gold. First came three large wooden, box-like shrines, one within the other. These were removed two winters ago, revealing a great sarcophagus of yellow quartzite with granite lid. This lid was raised, but the work was temporarily stopped. Last winter the stone sarcophagus was found to contain three coffins, nested one within another. All three coffins are shown above, although the resemblance of the sculptured effigies on each renders their individual identification somewhat confusing. In the center picture the first or outside coffin of the three is being lowered away from the second, which fitted into it too closely to be lifted out. Both are of wood, covered with sheet gold. The lower picture shows the second coffin alone, its golden shell encrusted with polychrome glass. The top picture shows it with cover removed, revealing the third and final coffin, partly concealed by the funeral wreath and shroud. This third coffin, with shroud removed, is shown at the left of the page. It is over six feet in length and was beaten out of solid gold. It is embellished with turquoise, lapis lazuli and carnelian.

Radel & Herbert

THE LUNGS OF A SUPER-BROADCASTER

By varying these flat condensers, the wavelength is sharpened to minimize interference. The two "pans" serve as verniers to the big condensers



Radel & Herbert

THE SWITCH OF A MODERN BROADCASTER

So powerful is WJZ that the oil-immersed switches are automatically operated by a motor which is controlled from the main switchboard

Radio Whirlpools in the Ether

Modern Broadcasting Plants Charge the Air With Powerful Electric Streams

By Orrin E. Dunlap, Jr.

RADIO waves are often pictured by the analogy of a stone hurled into a pond causing ripples to emanate in all directions from the disturbance center. The larger the stone and the greater the force with which it strikes the water, the larger will be the waves and the farther they will travel. Here the analogy ends because the power of radio waves is not dependent upon their size. The length of the Hertzian waves has little to do with the distance they will cover. The amperes in the aerial circuit and the pressure in volts between the aerial and the ground are what count in broadcasting.

This etherial energy may be very strong despite the fact that it is invisible. So powerful were the electromagnetic impulses broadcast from MacMillan's ship in the arctic that the electric lights on board would glow by radio power although the lights were disconnected from the current supply. One member of the crew told how he placed an incandescent lamp on the pillow in his bunk and when the transmitter was in operation the bulb would emit light.

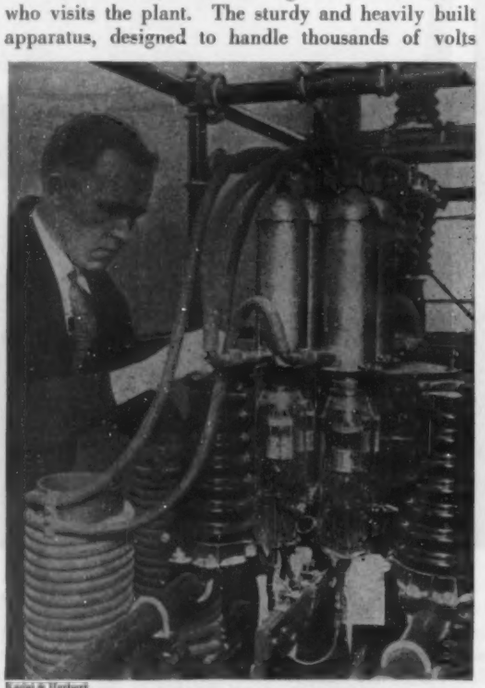
Microphone and Transmitter 35 Miles Apart

There are three spots in the ether of the United States whose turbulence may be pictured as waves created by a huge boulder. These etherial centers are: Bound Brook, New Jersey, Schenectady, New York, and Pittsburgh, Pennsylvania, where WJZ, WGY and KDKA respectively are located. Their impulses dwarf the waves radiated by the majority of stations into surface ripples.

Station WJZ was the last to join the super trio and for that reason the equipment may be considered the most modern, although the other broadcasters are constantly kept up-to-date.

Bound Brook, the home of WJZ's transmitter, is thirty-five miles from New York City, where the studio is located on the sixth floor of Aeolian Hall, 33 West Forty-second Street. There the entertainers actuate the microphone connected with the transmitter by a wire line which runs across Manhattan Island, through a submarine cable beneath the Hudson River and then overhead across the Jersey meadows to Bound Brook.

The new equipment on this New Jersey radio reservation astounds the average broadcast listener who visits the plant. The sturdy and heavily built apparatus, designed to handle thousands of volts and high amperage, reveals radio as an institution. It shows that broadcasting is no fad but an established public service destined for a great future both musically and otherwise, contrary to the prediction of Efrem Zimbalist that radio will die in two years.



Radel & Herbert

THE HEART OF BROADCASTING

A few of the ten-kilowatt tubes used at station WJZ, Bound Brook. Note the large insulators and the water-cooling system. The water jackets at the top of the tubes are supplied with running water through the coils of rubber hose

The station resembles a power house more than it meets the average conception of a radiophone installation. It shows radio expanded from one or two small rooms on top of a building to a stucco structure one hundred feet long and seventy-five feet wide with other smaller houses and aerial masts scattered over several acres.

Broadcasting started in 1920 and the new WJZ is the result of accumulated knowledge of lessons gleaned from practical experience during the past six years. The engineers have brought every refinement and improvement into this station. For example, the transmitting room is enclosed in a copper shell to prevent radiation of harmonics, or incidental waves, which would interfere with broadcast auditors in reception of other programs.

Prepared for Emergencies

The slender steel masts or wooden poles which hold aloft the aerial wires of most stations are dwarfed by the two 300-foot towers spaced 700 feet apart on the WJZ plot. The four legs of each tower rest in large porcelain insulators so that the energy will not leak down the steel framework into the earth. The aerial is a cage arranged in "T" fashion, that is, the lead-in is taken off the center of the aerial proper, which is approximately 225 feet long.

The ground is a radiating network of heavy copper wire buried several feet in the earth.

The main transmitter is located on the ground floor of the largest building. The current-supply transformers and motor generators are in the basement. The power supply of 4,300 volts is furnished by a neighboring power house and transformers step down this current to 2,300 volts for conversion into

direct current of approximately 10,000 volts. This is accomplished by vacuum-tube rectifiers supplemented by a bank of choke coils, whose duty is to aid in smoothing out the alternating current, to direct. The motor generators change the alternating current supplied by the transformers into 22 volts direct current for the purpose of lighting the filaments of the transmitting tubes.

The station has more than one transmitter. The main station, tuned to the 455-meter channel, is rated at 50 kilowatts. There are three of these high-powered units. One is a duplicate of the main installation and it stands ready to be switched into the etherial circuit in case of emergency.

The third transmitter is also rated at 50 kilowatts output and it is tuned to radiate waves under 80 meters in length. This equipment is used to span long distances, because the shorter waves, projected high into the upper atmosphere, seem to have less difficulty in reaching across the seas. Furthermore, some contend that long distance broadcasting in the future will gradually shift to channels below 100 meters and in that event WJZ will be prepared. In the meantime, tests will be conducted to study the vagaries of the ether and determine the value of short waves. It is not expected, however, that there will be a sudden adoption of short waves by all stations, because there are many mysteries yet to be solved in connection with the lower wave bands.

Puzzles Created by Short Waves

The story is told how several amateurs gathered at a short-wave station in New York with plans to spend the night in the radio room in an effort to talk to as many different sections of the world as possible. Australia, New Zealand, France and England were easily reached and two-way communication established on the 40-meter wavelength. Then the operators tried to attract the attention of any short-wave amateur operator who might be listening in the Chicago or Denver districts, but all in vain. The nearest they could get to the United States was an army station in Hawaii.

The signals seemed to shoot up to the Heaviside surface in the upper regions of the sky, not to be reflected back to the earth until several thousand miles away. These trick performances of the short waves create puzzles which the engineers of the new station will strive to solve. It is pointed out that if the long-distance skip-effect cannot be overcome, the short waves will never be practical for broadcasting as it is carried on today by the 200 to 550-meter waves.

Kadel & Herbert

TRANSFORMER ROOM AT BOUND BROOK

The motor generators are in the basement of the main building. Current supplied by a power house is 4,300 volts. These transformers reduce it to 2,300 volts and the generators change the alternating to direct current for the tube filaments

Each transmitter at Bound Brook has six oscillators and twelve modulator tubes, each capable of handling 10 kilowatts of power. A tube of this size requires for operation at full capacity, as much power as would be used to light simultaneously every room in a dozen six-room houses. The tubes are eighteen inches high and six inches in diameter. A water jacket, handling a flow of 3,300 gallons of water a minute, circulated under pressure, carries off the heat generated when the transmitter is in operation, as otherwise the tubes would melt. In order to obtain more than 10 kilowatts, several tubes are connected in parallel.

The power is so great that automatic switches immersed in oil and operated by electric motors, controlled from the main switchboard, are used to throw the knife blades of the switches into the desired position.

This transmitting set is a system of coils and condensers just like a receiving set, except that the broadcasting apparatus is built to handle heavy currents. By adjusting the inductance and capacity to a certain value, the transmitter is tuned to a definite wave, similar to the manner of tuning a receiving set. When the receiver's dials are revolved, the inductance and capacity of the circuit are adjusted so that the set is in resonance with a particular broadcaster.

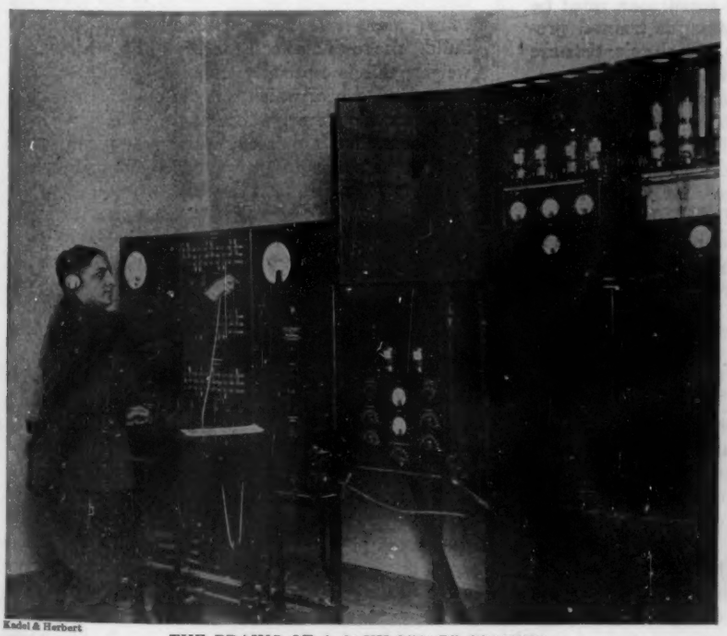
The coils of a sending station generally consist of heavy copper or brass ribbon. The condensers at WJZ are made of seven, thick, copper plates approximately six by two feet with the edges rounded. They are not housed by containers but are suspended from insulators. Air being a good dielectric, or insulating material, the plates are placed eight inches apart with nothing but air between them.

Waves Heard in Far-off Peru

The wires which connect the New York studio with the broadcasting apparatus terminate at a switchboard in the Bound Brook transmitting room. There the incoming speech and music forwarded from Manhattan in the form of electrical impulses are switched into the amplifiers and control unit. The amplifier consists of eight tubes, four rated at five watts and four at 50 watts.

One small but interesting structure on this New Jersey radio site is the home of a large variable condenser used for tuning the aerial circuit. The plates consist of large, copper sheets similar to those of the large fixed condensers mentioned above. This condenser is operated by a large electric motor.

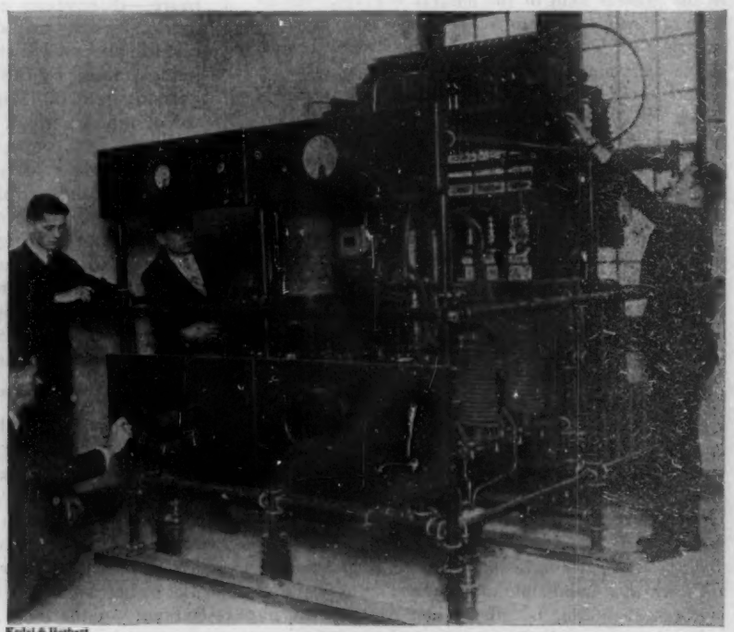
According to the engineers, WJZ seldom broadcasts on full power, but nevertheless, it is reported that the waves have been heard in Peru, in Germany, on the Pacific Coast and in every state in the Union. The station made its debut December 7, 1925, and the first two months of operation brought 65,000 letters to the studio reporting on the reception.



Kadel & Herbert

THE BRAINS OF A 50-KILOWATT STATION

The speech amplifier system and control panel of WJZ. Wires leading from the microphone in the New York studio terminate at this switchboard, 35 miles from the entertainer



Kadel & Herbert

A HUGE OSCILLATOR AT WJZ

Note the coils of rubber hose which carry water to the jackets of the vacuum tubes to keep them cool. By adjusting the large coil on top, the wavelength can be changed

MEMBERS OF THE AMERICAN SCHOOL OF PREHISTORIC RESEARCH INSPECTING A DOLMEN NEAR CARNAC, BRITTANY, FRANCE

Old Problems and New Methods in Prehistory

The Relations Between the Physical and Cultural Evolution of Ancient Man

By George Grant MacCurdy

Professor of Prehistoric Archaeology, and Curator of the Anthropological Collections at Peabody Museum, Yale University; Director American School of Prehistoric Research

OUR knowledge of fossil men is a late development, the significance of which could hardly have been realized without an apprenticeship in the study of fossil animals. In the days before vertebrate paleontology became a science, the bones of huge fossil animals, often uncovered by chance, were sometimes mistaken for those of a supposed prehistoric race of human giants.

The notion that there were giants in the olden days still crops out in spite of the interest now taken in the general field of the natural sciences. As an illustration, I venture to recall a page from my own experience. Some years ago I happened by chance to meet a young man in front of a large fossil leg bone (nearly six feet long and weighing 575 pounds), which had been mounted in the old building of Peabody Museum at Yale. The specimen was the thigh bone of a huge herbivorous dinosaur. The young man asked: "Is not that the leg bone of a giant?" I had to explain that the bones of all the fossil men of whom we have any knowledge do not average any larger than those of modern man and that in all probability the precursor of man was even smaller than man properly so-called.

Man Evolved Very Slowly

If students of human paleontology have had to wait longer for their science to develop, they have one advantage over students of the more lowly prehistoric animal forms in that man has left two kinds of evidence bearing on his past: skeletal remains and cultural remains; whereas other animal forms have left evidence bearing only on their organic or physical evolution.

Not only do we have these two kinds of evidence from which it is possible to gage man's physical and cultural evolution, but the evidence furnished by cultural evolution is the more complete of the two. Cultural change is much more rapid than physical change, hence it can be measured with a greater degree of accuracy, especially during the later periods of prehistoric time. It is probable that tool-using Hominidae lived half a million years ago, although the cultural and anatomical evidence therefor have not yet been found in direct association.

It is now conceded that both brain and body of *Pithecanthropus erectus*, the Trinil man of Java, were more like those of man than of any known ape. Judging from the endo-cranial cast, the cranial capacity was about 900 to 940 cubic centimeters; this compares favorably with the minimum of 930 to 1,000 cubic centimeters in modern man and is 300 cubic centimeters greater than that of the largest gorilla. The cast brings out unmistakably the close resemblance of the lower, or Broca, convolution of the brain (the region of motor control of speech) to that in man. Another notable feature of the cast is the great expansion of that portion of the temporal lobe, which in man is known to be the auditory speech center. In other words, the brain of *Pithecanthropus* was provided with the necessary cerebral mechanism for the motor control of the speech organs and for the recording of acoustic impressions.

The development of these two regions having to do (in man) with motor and auditory phases of articulate speech is in harmony with the character of the teeth, lower jaw and brain case. The temporal lines on the sides of the cranium are low and inconspicuous, indicating a very modest development of the muscles controlling the movements of the lower jaw which must have been of correspondingly slight build. The teeth also call for a jaw of relatively light weight; this is especially true of the anterior lower premolars, one of which was fortunately recovered. Professor McGregor, who made a careful study of this tooth, says the facets of wear and the contact area are such as to prove that the upper canine, which is always slightly larger than the lower, was small and hominoid; thus *Pithecanthropus*, with small premolars and canines, must have been manlike in possessing a short dental arch and a chin little if any less receding than that of Neandertal man.

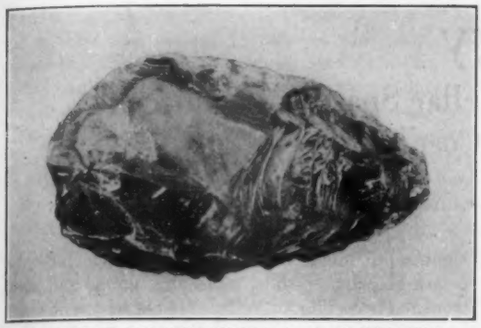
Piltdown Man Used Tools

While no artifacts were found in association with the skeletal remains of *Pithecanthropus* at Trinil, it would be hazardous to assert that he was incapable of their production and utilization. On the contrary the nature of his dentition, mandible, cranial musculature, and brain points to the reverse as being the more probable—a view which is strengthened by the finding in other parts of the world, notably England, of utilized flints in deposits approximately as old as those of Trinil.

If we accept the Trinil premolar as belonging with the cranium of *Pithecanthropus*, and if the lower-jaw fragment found some twenty-four miles east southeast of, and in the same geological level as Trinil

We Need More Facts

What the science of man's evolution most needs is more data. More—many more—discoveries of fossil man must be made. This work demands trained prehistoric archaeologists. Such scientists are being trained by the author of the accompanying article. Each summer, as Director of the American School of Prehistoric Research in Europe, Professor MacCurdy has led a group of people having serious interest in the problems of man's antiquity through most of the places of prehistoric note in England, France, Spain, Switzerland, Germany and Belgium, for the purposes of education and research. Professor MacCurdy is the author of "Human Origins," a recent and notable work on ancient man.



A TOPAZ SCRAPER-KNIFE, 50,000 YEARS OLD

This implement was chipped by an artisan of the Neandertal race, who inhabited a rock shelter in France

belongs to another individual of the genus *Pithecanthropus*, we have a lower jaw of slight build and almost vertical chin in combination with expansive brow ridges. This is just the reverse of the Piltdown combination with its receding chin, prominent canine and brow ridges no more prominent than those of modern man. Either the evidence is faulty or else our knowledge of nature's range in the way of experimentation is incomplete. In time we shall have sufficient evidence to dispel these seeming inconsistencies.

Fortunately at Piltdown, England, where the fossil skull of *Eoanthropus* was discovered, there is a direct point of contact between man's physical and cultural evolution—the association of artifacts with human skeletal remains. This association justifies us in assuming that *Eoanthropus* was a tool user. His mechanical operations were of the simplest kind, consisting first of the utilization of ready-to-hand tools such as the hammerstone or the natural flint flake, both of which may be called primary tools, since they require no preparation for service. The next step was the use of a primary tool, such as the hammerstone, by means of which it was possible to produce an artificial or secondary tool. The Piltdown man's kit of tools was thus a very simple affair.

The discoveries at Ehringsdorf and Taubach, near Weimar, Germany, consisting of chinless human jawbones, teeth, a femur and numerous flint artifacts, reveal another direct association of cultural with skeletal remains. The deposits in which they are embedded are interglacial, hence they are very old, perhaps over a hundred thousand years. There again the artisan's kit of tools remains the same—primary and secondary only—although there is some improvement in the technique. Cultural remains of interglacial man have been unearthed recently in Switzerland, especially at Drachenloch and Wildenmannlisloch; in both, the manufacture of tools did not rise above the secondary class of artifacts.

The great realm of art was beyond the reach of one who could command only the simplest mechanical aids; yet there is not lacking evidence that man was already beginning to reproduce (in his mind, at least) things other than mere tools, to find ways of giving form and encouragement to his mental images. For example, one of the finds at Wildenmannlisloch may serve to throw light on how man first came to be an artist. There is now a good deal of cumulative evidence pointing to the influence of fortuitous resemblances in nature to animal forms as bearing on primitive man's nascent artistic bent. Once detected, natural effigies would be gathered and treasured and means would eventually be found to supplement and improve on nature's haphazard creations. The specimen in question consists of a piece of lower jaw of the cave bear which has a striking resemblance to the human head and body; the concavity of the socket that held the canine forms the neck and chin. The piece bears evidence of a considerable amount of wear as if it had been carried as a fetish.

What Is a "Tertiary" Tool?

When we come to the Mousterian Epoch, or more properly that part of the Mousterian with cold fauna, there are nearly a score of localities where human skeletal and cultural remains are mingled; and they tell a consistent story—always the Neandertalian physical features, such as prominent brow ridges, low forehead, receding chin and scarcely erect posture, and an industry consisting of primary and secondary tools only. In so far as his mental horizon was concerned, there is nothing to indicate his superiority over *Eoanthropus* or the men whose relics we find at Drachenloch, Switzerland, except a slight improvement in the technique of chipping flint. By the time the last glacial epoch reached its maximum, the old Neandertal race and culture had spread over the habitable parts of Europe and the adjacent countries. A variety of the same species was recently discovered at Broken Hill in northern Rhodesia, preparing us for further discoveries of the type in other parts of the Old World.

MAGDALENIAN EPOCH JAVELIN THROWER

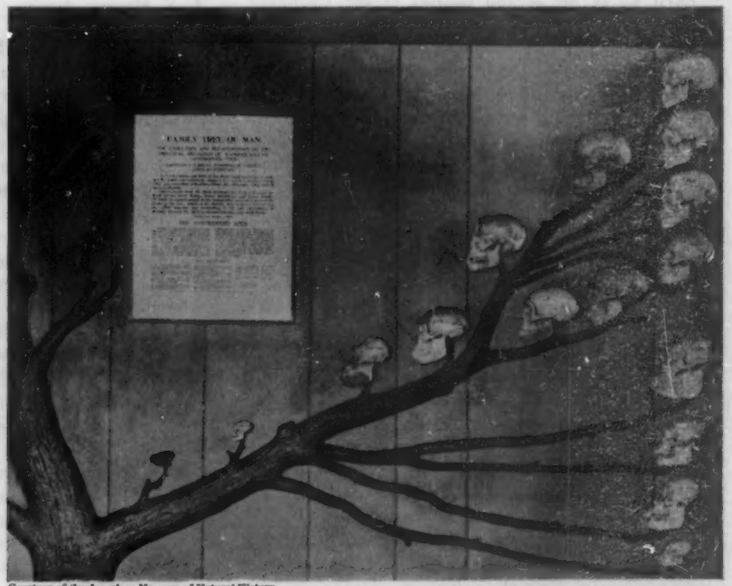
A good example of a tertiary tool. The handle is missing. The javelin was thrown from the crochet near the tail

It took a long time, perhaps half a million years, and apparently new blood, to break through the crust which limited the scope of man's activities as an artisan to the use of primary, and the manufacture of secondary tools. The event was a momentous one marked by the appearance of the Aurignacian, or early Cro-Magnon, race with a culture that included a tertiary set of tools—that is to say tools which required the use of primary and secondary tools in their manufacture and which were used for an ultimate purpose other than tool-making. The result from a material and spiritual standpoint can scarcely be overestimated. There followed as a natural consequence the cave-art period which marked the apogee of the food-gathering stage in civilization and prepared the way for the stage wherein man became a food producer.

The great enlightened public was never before so keen as now to follow closely in the wake of prehistoric discoveries. It is the duty of the specialists in this field to satisfy the demand for new knowledge as well as to train the general reader to distinguish between that which is merely spectacular and that which is important from the viewpoint of science. Explorations should, therefore, be conducted only by those specially trained for the purpose, who are equally aware of the significance of the problems involved, and who are versed in the best methods for their solution.

TRENCH DUG IN A ROCK-SHELTER IN FRANCE BY THE AMERICAN SCHOOL OF PREHISTORIC RESEARCH

Two ancient occupation levels, Neandertal and Cro-Magnon, were revealed. Among other objects found in this rock shelter of Castel-Merle, France, was the topaz scraper shown above



Courtesy of the American Museum of Natural History

EVOLUTION AND RELATIONSHIPS OF THE PRINCIPAL BRANCHES OF MANKIND AND THE ANTHROPOID APES

Pithecanthropus is shown in the "Pliocene" column, Eoanthropus almost above it. Neandertal man on the end of the short branch; Cro-Magnon man is above him

The New Cosmology

The Hypothesis that Atoms Are Being Evolved in Interstellar Space Is Confirmed by Millikan's Analysis of the Penetrating or Cosmic Rays

By William Duncan MacMillan
Professor of Astronomy at the University of Chicago

OUR grandfathers believed very firmly in the cosmogony of the book of Genesis. God made the heaven and the earth, the sun, the moon and the stars, and all the living things that inhabit the waters, the land and the air, in the space of six days, resting from all his labors on the seventh day; and all this occurred some six thousand years ago.

After a lifetime devoted to a mathematical study of the consequences of the law of gravitation as manifested in our solar system, Laplace was much impressed, a little over one hundred years ago, with the uniformities that occur in the motions of the sun's family of planets. Their orbits are very nearly circles; these circles lie very nearly in one and the same plane, the plane of the ecliptic, not very far from the equator of the sun; and finally, the planets all revolve about the sun in the same directions. As far as he knew them, they rotated on their axes in the same direction as they revolved about the sun, and the sun itself rotated in the same direction with them. The satellite systems also exhibit the same uniformities.

Could all this harmony be a matter of accident? Laplace answered with an emphatic "No! the present uniformities in the solar system are evidence of a dynamic past." And he proposed what has come to be known as the Nebular Hypothesis.

Death of the Nebular Hypothesis

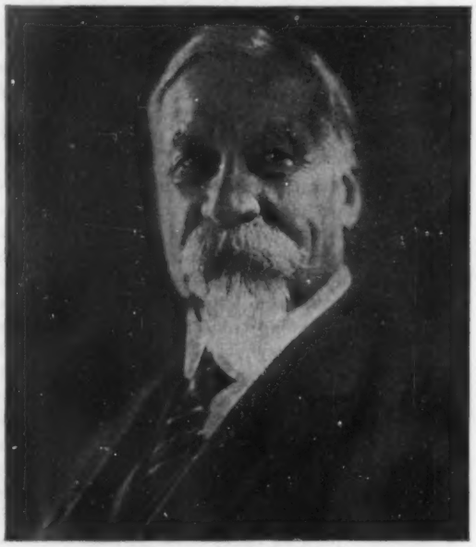
After the foundations of thermodynamics had been laid in the middle of the Nineteenth Century, Helmholz pointed out, in 1854, that the gravitational potential energy of the contracting nebula of Laplace was sufficient to furnish the sun with its present rate of radiation for twenty million years, and that this was more than twice as long a period of time as was required by the most radical of the geologists.

Even we of the second quarter of the Twentieth Century are compelled to admire the simplicity and beauty of the Laplace-Helmholz idea. It coördinated the scientific knowledge of the middle of the Nineteenth Century so harmoniously, and was so attractive in itself, that we are not surprised that our fathers believed in it as confidently as our grandfathers had believed in their conception of the story of creation in Genesis. It dominated the thoughts of scientific men during the entire century, and finally crystallized into a dogma, so that Lord Kelvin, in an address in 1899, stated its conclusions with a confidence and an authority that reminds one of the old Hebrew Prophets when they began "Thus saith the Lord."

For some time previously, however, the geologists had been restless under the restrictions as to time which were imposed upon them by the nebular hypothesis, and Lord Kelvin's address precipitated a revolt. In a paper which in its insight into the possibilities of atomic physics seems almost prophetic, and which was published in *Science* of the same year, T. C. Chamberlin, Head of the Department of Geology of the University of Chicago, sharply, but courteously, challenged not only the conclusions of Lord Kelvin, but also the foundations on which those conclusions rested.

Chamberlin's paper marked the beginning of a new era in cosmogony. Associating himself with F. R. Moulton of the department of astronomy, a mathematician of high attainments, not only were the weaknesses of the nebular hypothesis subjected to adverse criticism, but a new hypothesis was put forward, an hypothesis which Chamberlin called The Planetesimal Hypothesis.

The central idea of the old cosmogony had been rotational instability: rotational instability of gases in the nebular hypothesis of Laplace; rotational instability of liquids in the fission theory of Poincaré and Sir George Darwin as to the origin of the moon. The central idea of the new cosmogony was the close approach, but not collision, of two stars, one of which was our own sun.



PROF. T. C. CHAMBERLIN
Noted geologist of the University of Chicago who, with Prof. F. R. Moulton, developed the Planetesimal Hypothesis

It was a bold flight of the imagination, for never before had contact with the outside universe been brought seriously to our consideration. The inception of our family of planets was bi-parental, not mono-parental as had formerly been thought.

Much study has been given to the planetesimal hypothesis during the quarter of a century which has just elapsed, but it has stood the tests well. No fatal flaws have developed. There are many difficult problems, to be sure; but nature very rarely places problems that are mathematically simple before us, just enough, perhaps, to keep us struggling forward without complete discouragement.

Many astronomers and geologists, perhaps most of them, believe that the Planetesimal Hypothesis sketches in the large outlines of the past history of the earth and her sister planets. Filling in the details will be the work of the future.

The problems of cosmogony have been a favorite theme for more than a century, but the gigantic strides of the physicists and the observational astronomers for a generation past have placed before us a field even larger than that of cosmogony, the cultivation of which I have ventured to call cosmology. As used hitherto, the word "cosmogony" means the study of the origin of those forms which are visible in the sky—and therefore it deals with the past. Its significance might well be extended to include the origin of cells, crystals, molecules, atoms and electrons. The origin of cells, crystals and molecules has received a great deal of attention, but there has been very little discussion of the origin of atoms and electrons.

The term "cosmology" signifies the effort to coördinate all of the physical processes which we can detect in the visible universe, and to derive from that coördination all of the inferences which logically flow from it, whether they refer to the past, the present or the future. It represents the widest possible aspect of the transformations of energy and of those temporary localizations of energy which we call the physical units—electrons, atoms, crystals, stars, and so on; for I take it that we have all learned the lesson that in the study of the physical units we find nothing but energy and organization: that solid, unorganized, little something or other which we thought of as "matter," has vanished into the realm of myths.

In studying the physical units, therefore, we have to deal only with energy and the properties of its organization.

Science Does Not Recognize Creation

The foundations for the study of the motions of the celestial bodies were laid by Newton when he formulated the laws of motion and the law of gravitation, and developed the mathematical machinery (the calculus) which is necessary for tracing out the consequences of these laws. The tremendous successes won by the students of celestial mechanics, from Newton to Poincaré, have been considered by many as the crowning glory of the human intellect. When we rise, however, from the study of local systems, such as our planetary system, or binary and multiple stars, to aggregates of stars such as globular clusters or star clouds, the number of the objects to be dealt with is so great that we are compelled to resort to statistical methods for such meager information as we possess.

Nevertheless, thanks to Charlier and Kapteyn and many others who have followed in their lead, we have a certain fund of information with respect to the dynamics of stellar aggregates, such as the globular clusters, star clouds, or even such an aggregate of star clouds as our own galaxy, which is very precious. As might be expected *a priori*, the time-scale for these vast objects rises with the linear-scale, so that observable changes in their internal organizations are to be measured in thousands of billions (10^{12}) or even millions of billions (10^{18}) of years.

One of the fundamental events in such an aggregate is the close approach of two stars. If for the sake of a suitable unit we call a million billion years an "eon," then the expectation of the sun that some other star will approach it as close as the earth does, is *once in four eons*, on the average. To one who is accustomed to such periods of time as were granted by the Helmholz theory of the origin of the sun's heat such figures seem fantastic and unreal, and they were dismissed at first as such, with a feeling, unexpressed perhaps, that the galaxy had been created much more recently than that.

Science, however, does not recognize "creation," for it has no means of dealing with it. These vast

stellar aggregates are there, before our very eyes, and these vast periods of time go with them. We cannot dodge the facts, however startled we may be. Nor can we believe that the stars were all dark and cold until a hundred million years, or so, ago, when they all suddenly became bright, virtually simultaneously, and that in a few more million years they will all be dark again, their energies spent and gone. We cannot doubt that, however much the brightness of the individual stars may fluctuate, the aggregate as a whole has been shining as we see it now for periods of time that are to be measured by eons.

In the face of such a situation how pitifully inadequate is the contraction theory of the origin of the sun's heat!

The Cycle of Energy

Meditating upon these difficulties some ten years ago (1915); wondering at times what becomes of the vast floods of energy which the billions of stars are pouring unceasingly into space, notwithstanding that space is still dark and cold; and wondering, at other times, whence came the great stores of energy which the physicists were revealing in the atoms, there occurred to me the possibility that the birthplace of the atoms was in the depths of space, and that the source of their energies was the radiant energies of the stars.

The hypothesis that this is so accounts for the blackness of the night skies, and it accounts, too, for the existence of that nebulosity of space with which the cosmogonists have been wont to start their systems. It does more than that: it solves the problem of the stellar energies. If the radiant energy in space can be locked up in a new organization, an atom, which possesses the properties of mass and gravitational attraction, where mass did not exist before, then under the violent stresses which exist in the interior of the stars that organization can be destroyed, and its energy, released, again will take the radiant form.

One can account for an indefinite period of luminosity by merely supposing that the stars gather in as much energy in the form of nebulous matter as they radiate in the form of light and heat.

This suggestion, which harmonizes well with the astronomical facts and seems to have no fatal encounters with any of them, was published in the *Astrophysical Journal* in 1918. In the following year it was found that the physicists had already prepared a model in the theory of the electrons which responded to all the requirements of the case.

Courtesy of Mt. Wilson Observatory

A GREAT SPIRAL NEBULA ON EDGE

Doubtless this universe of suns is similar in a general way to the one shown below

If a positive and a negative electron unite in such a way that there is an exact superposition of their electrical fields, then their electrostatic potential energy would take the radiant form and the combined unit would not possess the property of mass, since mass depends upon the existence of the electrical fields. Furthermore, if the distance at which the potential energy takes the radiant form is the radius of the positive ion, the amount of energy can be computed. It is so great that the present mass of the sun would last for fifteen thousand billion years! The physicists have indeed relieved that embarrassment of the astronomers at the Bank of Time, and we are grateful to them for it.

The suggestion that a positive and a negative electron may neutralize each other with the loss of the property of mass, however, is not altogether new. So far as I know, it was first put forward by Jeans in 1904 in an effort to account for the phenomena of radioactivity. It did not seem to fit that situation, and the idea was not further developed.

In 1905 Einstein showed that, in accordance with the principle of relativity and the electromagnetic equations, one gram of matter is equivalent to 9×10^{20} ergs of energy, a figure that differs by about two percent from that which has just been derived from the electrostatic potential energy. Einstein further remarked that, on account of the radiation of its energy, the mass of the sun was declining at the rate just mentioned. He made no suggestion as to the origin of the sun's heat; doubtless because he was too busy developing other ideas. It might be added that hypotheses similar to those described above have been put forward in the past eighteen months by Jeans and Sir Oliver Lodge in England and by Nernst in Germany.

The hypothesis that atoms are being evolved in interstellar space, with a consequent loss of radiant energy, and that they are being destroyed in the interior of the stars, with a consequent release of radiant energy, leads to a wonderful expansion of our cosmological ideas. Atoms are certainly being evolved somewhere, and their large numbers suggest the depths of astronomical space. Millikan's recent conclusion from his analysis of the penetrating radiation, that something having to do with the nucleus of the atoms is going on in interstellar space, is a striking confirmation of the hypothesis. The evidence has come much more quickly than anticipated.

The Earth's Final Fate

There is not space in the present article to develop the consequences of this cycle of energy—from star to atom, and from atom to star—but I cannot refrain from mentioning a natural extension which it suggests to the Planetesimal Hypothesis of Chamberlin and Moulton. Planetary systems have their origin in the close approach of two stars, and in view of the eons during which the galaxy has existed, planetary systems must be numerous throughout the galaxy and many of them much older than ours.

This leads us to enquire "What is the old age of a planetary system?" The answer is that during the long ages of galactic time the planets, too, gather in meteoric and nebulous matter, and grow. As they grow they draw closer together and their mutual perturbations increase. In our own system the smaller, terrestrial planets, one by one, doubtless, will be thrown into the sun. Jupiter will grow up to starhood. Quite likely the outer planets too, eventually, will meet the same fate as the smaller ones, and the sun and Jupiter alone will be left to form a binary star. Youthful planetary systems become binary or multiple stars in their old age.

The revolt which was led by T. C. Chamberlin against outworn ideas twenty-seven years ago has been most fruitful in its consequences.

Courtesy of Mt. Wilson Observatory

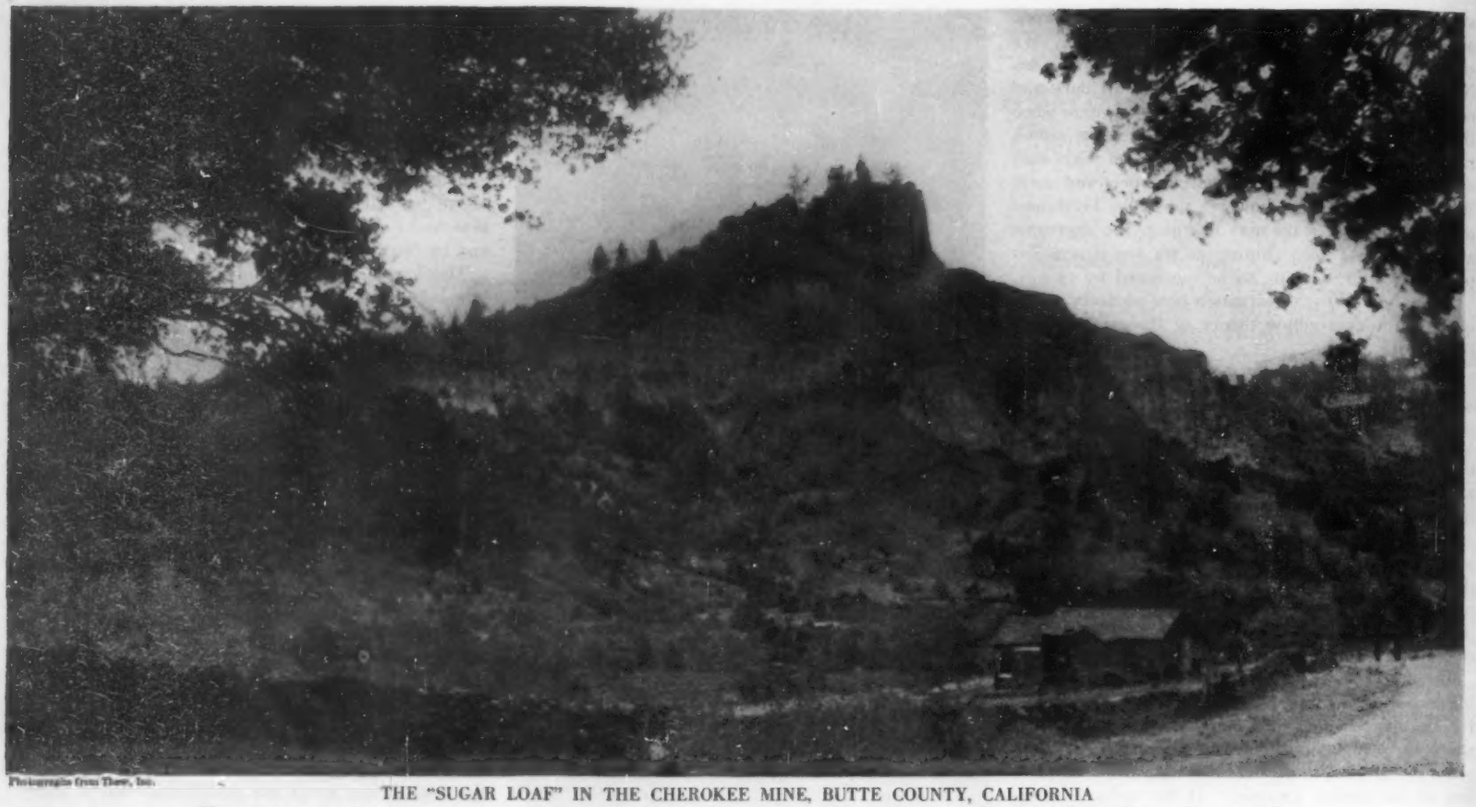
IMMENSE ERUPTIVE PROMINENCES OF THE SUN

"At short intervals great bolts of sun-substance are shot forth at high velocities," says Chamberlin in "The Origin of the Earth." Should another sun now pass by, planets might be born

Courtesy of Mt. Wilson Observatory

SPIRAL NEBULA CONTAINING MILLIONS OF SUNS

Prof. MacMillan suggests that the Penetrating Radiation, recently studied by Millikan, may be generated when atoms are being evolved in the depths of interstellar space



Photograph from Thew, Inc.

THE "SUGAR LOAF" IN THE CHEROKEE MINE, BUTTE COUNTY, CALIFORNIA

Many years ago a miner sent a prospect tunnel into Sugar Loaf and found what is believed to be a chimney of diamondiferous blue ground

A Diamond Quest in California

Cherokee Mine, Once One of the Richest Gold Producers, May Now Become a Diamond Mine

By Winfield Scott

SOMEWHERE in the Cherokee Mine, located twelve miles north of Oroville, California, there is believed to be a blue clay pipe or chimney which carries diamonds. Several hundred diamonds have been found in this mine, but no systematic search for this chimney has ever been made.

READY FOR PANNING

Panning was one of the operations incident to early day gold mining. Our photograph shows one of the miners, William Fliedner, better known as "Happy Jack," on the job

Many years ago Alexander M. Wilson, a miner who lived in Cherokee forty years, sent a prospect tunnel into what is known as the Sugar Loaf, at the Cherokee Mine. Wilson remembers very distinctly running across a formation of blue ground, which corresponds in every particular to the description of the blue ground which is mined at Kimberly, South Africa. This ground carries the largest portion of the diamonds which now come from South Africa.

Always a Rich Gold Producer

Cherokee has always been a great gold property. It produced millions of dollars before hydraulicking was stopped in California many years ago. After hydraulicking ended, the owners of the property, the Vintin family, never made arrangements for an impounding dam in which the hydraulic mining debris could be retained and thus prevented from falling into the tributaries of the Sacramento River. Lack of funds alone has prevented a debris dam from being constructed and the Cherokee Mine from continuing as one of the state's largest producers of gold.

Some years ago the water right to the property was sold to a public service corporation operating in California, and now the great Cherokee Mine, once one of the richest gold producers in California and still containing literally millions of dollars in gold dust, lies idle. Engineers have said, however, that several practicable sources of water are still available.

With the water gone and with debris impounding not solved the days of the Cherokee as a gold producer appear to be over. There it is, a great pit torn out of the side of the hill and out of a valley; perhaps five miles long, perhaps two miles wide. Over it broods silence and the sun. The bed of the mine is one great mass of boulders, some as large as an ordinary sized room. In and around these boulders individiual miners are digging away for "muck," which they wash in the most primitive

ANOTHER MINING OPERATION

Getting out "muck" (gravel) from between the boulders in the bed of the Cherokee Mine. The gravel is sifted and examined for diamonds before being washed for gold

TWO EARLY-DAY METHODS

Fliedner, in manipulating his pan, found a globule of quicksilver in a ditch running away from the Cherokee Mine. It had evidently been lost in early mining operations

manner and out of which come some diamonds as well as gold.

Several hundred stones in all have been found since 1866, when Mike Maher, a Cherokee miner, picked up what is said to be the first stone discovered in the district.

Campbell De Beck, a Belgian, mined with a group of fellow countrymen in the early 80's and found eighty stones. Louis Slissmar, an Oroville theatre owner, declares that his father, who once mined at the Cherokee diggings, found twenty stones incidental to his gold mining operations.

Blue Ground Stimulating the Search

All the diamonds thus far discovered in the Cherokee Mine show little effect of water washing either by chipping or otherwise. The crystalline structure of the diamonds is spendidly preserved. This fact is taken as proof, by the three or four men who are unostentatiously digging in the bed of the mine that the original source of the stones is not far away. This circumstance and the location of blue ground found by Wilson many years ago, are stimulating the present search.

Douglas B. Sterrett, of the United States Geological Survey, reported in 1906 in regard to a spasmodic effort to locate the original source of the diamonds as follows:

"Just what the nature of the matrix will be is not known. It may not be a typical kimberlite rock and in the form of a volcanic neck, but one of the great varieties of basic igneous rocks so plentiful in the region. It has not been proved that a kimberlite in formation is essential to the occurrence of diamonds nor that where such a rock exists it must carry diamonds."

Aside from the little known, although recently reported, diamond discoveries in Arkansas, not much can be said for diamond working in the United States. Schoolboys of an earlier era were told in their text-books that the largest diamond ever found in the United States was one of 23¾ carats which was picked up in 1885 in Manchester, Virginia. This stone was in later years known as the Dewey diamond.

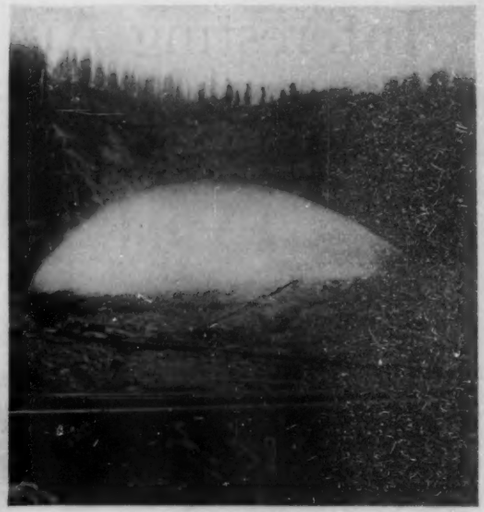
A PROSPECTOR'S FIND

Diamonds and gold from the Cherokee Mine. At the left is shown a cut diamond set in a ring, in front of it a rough diamond. A pile of gold nuggets of varying sizes and in great abundance is shown at the right

Diamonds have been reported in Virginia, Georgia, South Carolina, North Carolina, in the Eastern Appalachians, and also in Wisconsin, Michigan and Ohio. Middlewestern finds have always been in the glacial drift; and the original location is usually supposed to have been somewhere in the north, in the Hudson Bay country.

The miners who are hopefully prospecting the Cherokee property in California are not looking for diamonds in gravel; and yet it must be remembered that prior to the discovery of the South African mines the only source of these gems was from river gravel.

The Golconda district in India was exhausted about the Seventeenth Century, and no large diamonds were found prior to 1000 A.D. Golconda itself was merely a market for the stones, which were obtained from a district on the east side of the Deccan all the way from the Pinner River in the Madras Presidency to the rivers Sun and Kahn, which are tributaries of the Ganges.



A THING OF THE PAST

In the early days, hydraulic mining was employed at Cherokee Mine. This form of mining was stopped long ago, however, and is now all but a memory in California

A Precious Plaything

The Brazil diamonds, which were first known about 1725, remained the principal source of new stones until 1867, when the children of Daniel Jacobs, a Boer farmer near Hope Town on the Orange River, picked up a bright, white stone and used it as a plaything. It was a diamond weighing 21 8/10 carats.

From the finding of this stone by a child dates the modern history of South Africa.

In British Guiana and in Borneo there is some diamond production. Diamonds have come also commercially from the Ural Mountains and New South Wales.

The plans of the prospectors in the Cherokee Mine have been carefully covered up. There is no doubt that there are diamonds in the mine, and that should the precious matrix in which they hide be discovered, Cherokee, a dwindling mining town of '49, will be re-born and will be the scene of all the bustle and excitement of former days.

BED OF THE CHEROKEE MINE

In this mine, many years ago, diamonds were found. The "blue ground" chimney, in which the diamonds were formed, is believed to be somewhere in the "Sugar Loaf," at the left

ALL THAT REMAINS OF CHEROKEE

Once a busy town, straggling for a mile along the roadway, it is now a place that lives in the past. Perhaps, some day, it will be once more the scene of feverish activity

Interesting Air Stamps and Historic Cancellations

Some of the choicest examples of air stamps—aviation's contribution to stamp lore

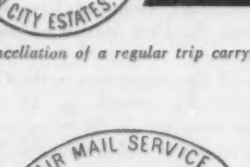
Card carried by the Airship R-34 on the record transatlantic trip

All Uncle Sam will let us print of our air stamps

Cancellation first New York-Chicago mail

Amundson took a limited number of postcards on his polar expedition

First cancellation of a regular trip carrying mail



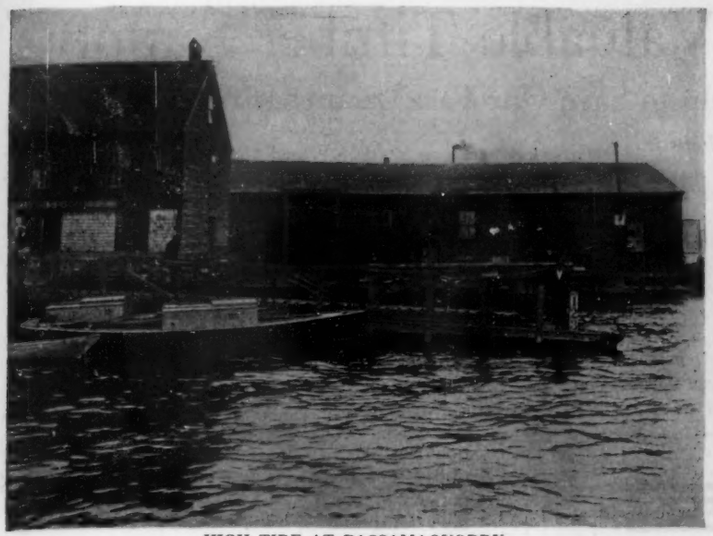
Cancellation first trip San Francisco-New York

Japanese cancellations are very artistic

K.u.k. Festungsartillerieregiment
Fürst Kinsky Nr. 3.
Festungsballonabteilung Nr. 1.

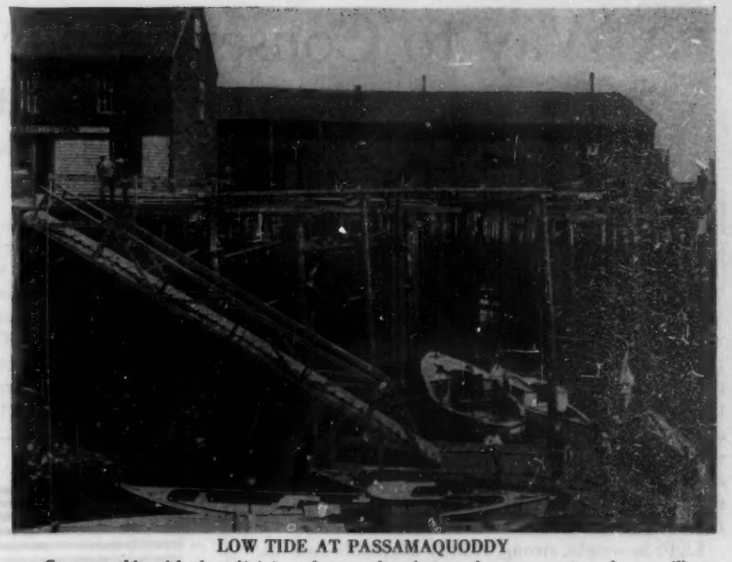
Cancellations of Turkey, China, Siam and a military cancellation during the siege of Przemysl

The air stamps of all nations furnish a happy hunting ground for the stamp collector



HIGH TIDE AT PASSAMAQUODDY

The Bay of Fundy experiences the greatest tidal range of any known body of water. In places this is from 40 to 50 feet



LOW TIDE AT PASSAMAQUODDY

Compare this with the adjoining photograph, taken at the same spot, and you will appreciate the latent tidal power of these waters

Horsepower From the Tides

Proposal to Develop Half a Million Horsepower at the Bay of Fundy

By J. Bernard Walker

FROM time to time, we have recorded in the Scientific American various attempts to utilize the energy of the sea, as expressed in its undulating waves or in its ebbing and flowing tides. One of the latest of these attempts and certainly the most ambitious, was the proposal (since abandoned) to build a great dam and power house across the River Severn and thereby secure a continuous supply of hydro-electric energy of 500,000 horsepower.

And now comes a well-known hydraulic engineer, Mr. Dexter P. Cooper, who has done notable hydraulic work, particularly in connection with the construction of the great Keokuk Dam across the Mississippi, with a proposal to harness for industrial purposes the famous tides of the Bay of Fundy.

A Stupendous Undertaking

Mr. Cooper has selected for his stupendous undertaking two considerable indentations off the eastern coast of Maine—one known as Passamaquoddy Bay and the other as Cobscook Bay. These two bodies of salt water adjoin each other and are almost completely shut off from one another and from the waters of the Bay of Fundy by a continuous chain of islands. The islands are separated by narrow inlets, through which the tide enters and leaves the two bays. The northerly or "upper pool" has an area of 106 square miles; the "lower pool" has an area of 46 square miles. Now, it was the topographical lay of the land and sea at this point which suggested the possibility of utilizing the rise and fall of the tide for power purposes.

"I will enclose the two pools," said Mr. Cooper, "by building a series of dams between the islands and provide them with regulating gates to control the inflow and outflow of the tidal water. I will so regulate the flow that the large upper pool shall be maintained at a relatively high level and the lower pool at a relatively low level, thus obtaining a permanent hydraulic head. Then, by building a dam between the two pools, I can place my turbines within it and secure a continual operation of the turbines throughout the 24 hours of the day."

The flow of the Bay of Fundy water is always *into* the upper pool as shown by the arrows. Also, as shown by the same indications, the flow at the power house is always from the upper to the lower pool, and from the lower pool the flow is always *outward* into the Bay of Fundy.

The total cost of the project will be about $100,000,000, and the dams with their gates will total about 14,500 feet in length. As shown by the map, the principal island off Passamaquoddy Bay is Deer Island and north of it there will be two dams, each provided with gates for the control of the water. At the northerly dam, there will be a lock. A dam will also be built from Deer Island to the land near Eastport. Between Eastport and the mainland, there will be two other dams, each provided with gates for the outflow of water from the lower pool. The dam near Eastport, must be built in water that is 175 feet deep, and flows in and out of the pool with considerable velocity. It is proposed to fill up this gap by dumping large boulders until the structure has reached the surface. Above that point, smaller rock would be used on the side facing the pool and the structure would be rendered tight by a mixture of clay and gravel.

HOW THE POWER IS DEVELOPED

Map showing the system of dams, gates and turbines by which it is expected to develop 500,000 horsepower

Every one of the dams will be provided with gates for the control of the water level in the two pools. Twenty gates will be required for the upper pool and ten for the lower pool. In addition to the locks mentioned above, at the northerly end of the chain of islands, there will be another lock at the Deer Island end of the large dam. This lock will be 800 feet long, 110 feet wide, with 30 feet of water over the sill.

Controlling the Tidal Fall

At high tide, the gates into the upper pool will be closed and, as the upper pool water passes through the turbines to the lower pool, it will continue falling until its level reaches the level of the next rise in tide outside the gates, when the gates will be opened and the pool will be filled again to high-tide level.

The lower pool will reach its bottom level at low water of the Bay of Fundy. The gates will then be closed, and as the water passes through the turbines of the power house, the surface level of the lower pool will rise until it reaches the same level as the falling outside tide, at which point the gates will be opened allowing the level in the pool to fall to low-tide level. By this arrangement of dams, controlling gates, and turbines, between the two pools, there will always be maintained a sufficient head of water for operating the turbine continuously. Mr. Cooper estimated that the maximum head would be 24 feet, the minimum head 10 feet and the average head throughout the 24 hours would be from 14 feet to 15 feet. The total output at low head will be 500,000 horsepower.

A Way to Conserve Our Valuable Timber Supply

How Industrial Wood Preservation May Help to Save Our Fast Disappearing Forests

By R. K. Helphenstine, Jr.

OF all the products of the earth, wood has probably been the most valuable to and most closely associated with the human race in its advance toward civilization.

Aside from being a daily essential to man's individual welfare, wood has been a raw material indispensable to the birth, growth and very existence of great national enterprises. Navigation, the construction and maintenance of railroads, the perfection and upkeep of telephone and telegraph lines, the operation of mines, and many other large industries have always been and will continue to be dependent upon a continuous supply of timber of high quality in various structural forms.

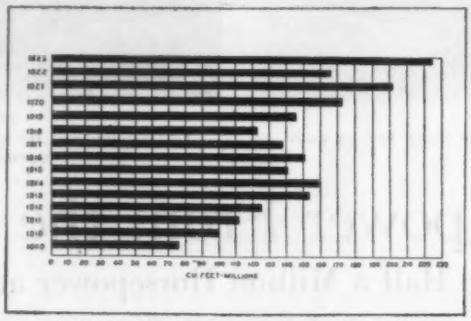
Light in weight, strong, readily adaptable and low in price, wood is the ideal material for construction. While all wood is not durable, it can be made so at small cost by preservative treatment, and there is a preservative and a method of applying it suitable for practically every need.

Our Vanishing Forests

Official government estimates place the original forest area of the United States at 822 million acres, representing a stand of at least 5,200 billion board feet of timber. Today, only 463 million acres of forest land remain, supporting approximately 2,214 billion board feet of merchantable timber, or less than two-fifths of the country's original forest wealth. Furthermore, only one-sixth of the original forest area now remains in virgin timber.

The total amount of wood used and destroyed annually in the United States amounts to approximately 25 billion cubic feet. This includes lumber and timber, crossties, piles, poles, fence posts, mine props, and the various other classes of primary products for which wood is the raw material used. It also takes into account four billion cubic feet, the estimated annual preventable loss of wood in service through decay alone. As compared with this enormous consumption, it is estimated that but six billion cubic feet of wood is produced through annual growth.

In other words, therefore, the standing timber of the country is being cut and destroyed nearly four and one-half times as fast as it is being replaced by growth. At this rate of consumption it can be readily seen that unless vigorous action is taken at once looking to conservation and reforestation the remaining supply of timber will last but a comparatively short time. The nation must, therefore, in order to meet future requirements, not only grow timber, but must also practice the most strict economy in the utilization of that which remains. Wood preservation presents one important channel through which such economy can be rigidly enforced.



WOOD TREATED IN THE UNITED STATES
The wood-preserving industry has shown a truly remarkable growth

Wood, although possessing as wide a range of uses as any other raw material, has always been handicapped by the fact that, when exposed to conditions fostering decay, it may last but a comparatively few years. One of its great advantages in past years has been its relative cheapness; but, as a result of timber depletion, this advantage has been growing steadily less as the cost of wood has mounted higher and higher. To lay a section of railroad track, to timber a mine tunnel, or to construct a bridge with woods best suited to each class of project costs today several times as much as it did twenty years ago.

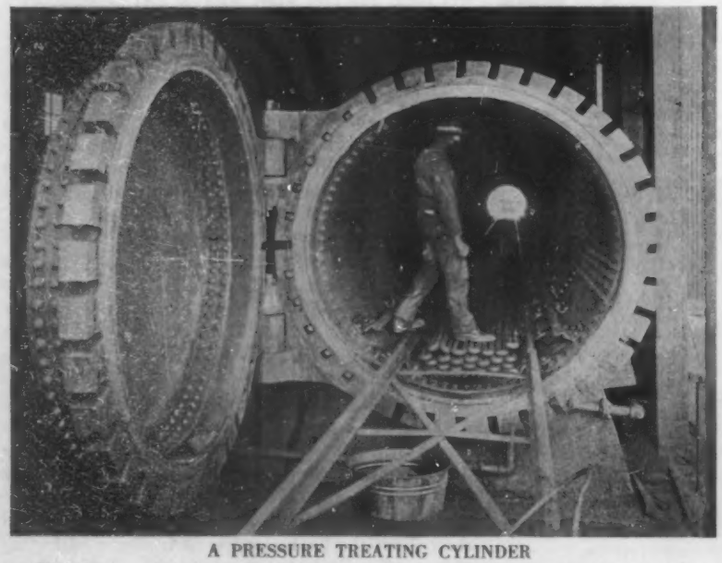
The gradually increasing difficulty in obtaining the more adaptable woods of the correct size and quality is the cause in no small part for the increased cost, as well as for the tendency to substitute poorer species. Thus the scarcity and resultant high price of the better woods and the exceedingly short life of the cheaper ones presented a problem, the solution of which gave birth to the wood-preserving industry.

The preservation of wood does more than merely prolong its life. It permits of the use of less durable woods that were formerly considered unsuitable, but which, when treated, will last as long as any others. It gives the user a wider field of selection for his material and enables him to obtain satisfactory stock at a reduction in cost. It often permits of the use of local species, thus obviating high transportation costs. It lessens the demand for the better species, thus making them available for more exacting uses.

Methods of Preservation

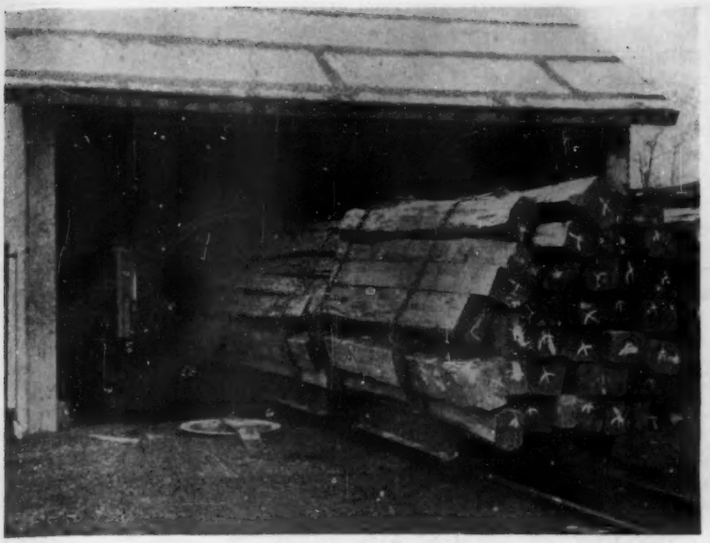
Coal-tar creosote and zinc chloride are the two preservatives that have become standard in commercial practice in this country and are used in the largest quantities. Others are also employed, however, such as mercuric chloride, sodium fluoride, paving oil and a number of proprietary preservatives, but usually only in relatively small quantities for special purposes. Coal-tar creosote is used for the treatment of wood for all classes of construction. Zinc chloride is soluble in water and is liable to leach out of wood when placed in wet situations. For this reason its use is largely confined to the treatment of timber for building and other construction in comparatively dry locations. In the southwest and other regions where there is a minimum of rainfall it is extensively employed in the treatment of crossties. This preservative is also admirably adapted to the treatment of wood in house construction, where it is usually painted or where the color or odor of creosote would be objectionable.

The essential properties of a satisfactory wood preservative are that it should be poisonous to wood-destroying fungi and insects, that it should not weaken the wood, should be of uniform composition, and should be available in large quantities at low cost. Coal-tar creosote and zinc chloride have been



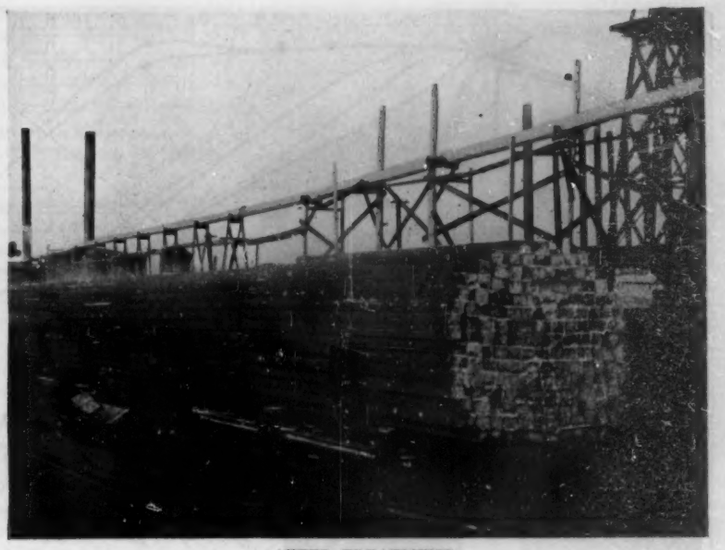
A PRESSURE TREATING CYLINDER
This close-up view shows the detail of the door construction, the arrangement of the heating coils and the comparative size of the cylinder

A TYPICAL WOOD PRESERVATION PLANT
The cylinder on the left contains timber undergoing treatment, while that on the right is open and ready to receive timber for treatment



BEFORE TREATMENT

A load of crossties entering cylinder for preservation treatment



AFTER TREATMENT

A trainload of crossties shortly after removal from cylinder

found to meet these requirements most successfully.

In the preservation of wood, treatment is applied either by pressure or non-pressure methods. The former is the more effective, because the preservative is forced into the wood under pressure and deeper impregnation is secured. Furthermore, under the pressure method, penetration is subject to control, and both the penetration and the preservative can be varied to meet different requirements, thereby resulting in the economical use of preservatives.

Preserving Industry Has Trebled in Size

Although the pressure treatment of wood gives the best results, the material to be treated frequently does not warrant the expense necessary to install the requisite equipment for this type of treatment, and non-pressure methods are employed. These comprise the hot and cold bath, soaking, dipping, and the brush coating or spraying methods. Of these the hot and cold bath (open tank treatment) is the method most commonly employed commercially, especially in the butt treatment of poles. For the dipping, soaking and brush coating methods creosote is the preservative ordinarily used, while in the open-tank method either creosote or zinc chloride is employed. Where the timber is well seasoned and treatments are carefully made the added life secured by non-pressure treatments fully warrants the expense.

A modern pressure wood-preserving plant consists mainly of one or several treating cylinders six or seven feet in diameter and from 80 to 170 feet long. These cylinders are sufficiently strong to withstand a working pressure of from 125 to 200 pounds per square inch, and are provided with coils inside for heating the preservative. The cylinders are mounted on foundations in a horizontal position and are fitted inside with a narrow-gage track to carry the tram cars containing the wood to be treated. In operation the cars with their loads of timber are propelled into the cylinder in trains, and the door at each end is closed. After treatment, the material is removed and loaded for shipment. In addition to the treating cylinders a pressure plant is also equipped with storage and measuring tanks for the preservative, the necessary pressure and vacuum pumps, and apparatus for steaming the timber preparatory to treatment when necessary.

In 1909, the first year for which statistics of the industry were gathered, there were in existence in the United States a total of 64 treating plants. In 1923 the number of treating plants that were in active operation was 135. Of these 81 are commercial plants that treat wood for sale or by contract, 29 are owned by railroads and specialize in the treatment of railroad material, and 25 are private plants belonging to mining companies or public utility corporations that treat wood in various forms for their own use.

The plants that were active in 1909 consumed 51,426,212 gallons of creosote and 16,215,107 pounds of zinc chloride, as compared with 127,417,305 gallons of the former and 28,830,817 pounds of the latter that were used by those plants that were in operation in 1923.

A COMMERCIAL OPEN TANK PLANT

The non-pressure method is most commonly employed commercially for the butt treatment of poles

In 1909 the total quantity of wood treated was 75,946,419 cubic feet, while in 1923 that which was subjected to treatment amounted to 224,375,468 cubic feet.

From the above statements it can readily be seen that in a few short years the wood-preserving industry has shown remarkable growth.

The railroads, the pioneers in the wood preserving field, have long been cognizant of the economic value of treated wood. As a result, the bulk of the material treated each year has consisted of crossties, crossing plank, bridge and trestle timbers and similar products of the forest in structural form essential to the profitable and safe operation of the rail transportation system of the country.

The splendid example set by the railroads has been followed increasingly each year by other large industries. Mining companies are now important users of treated wood in the form of props, and other mine timbers; telephone and telegraph companies depend upon treated poles and cross-arms to insure permanency in their equipment; and docking and terminal and constructing companies draft their specifications for structural timber with special reference to preservative treatment. Furthermore, in the national and state programs for public works, highway construction, and the improvement of navigation, treated wood plays an important part in the form of bridge timbers, fencing, guard rails, piling, foundations, and so on.

Treatment Doubles Life of Wood

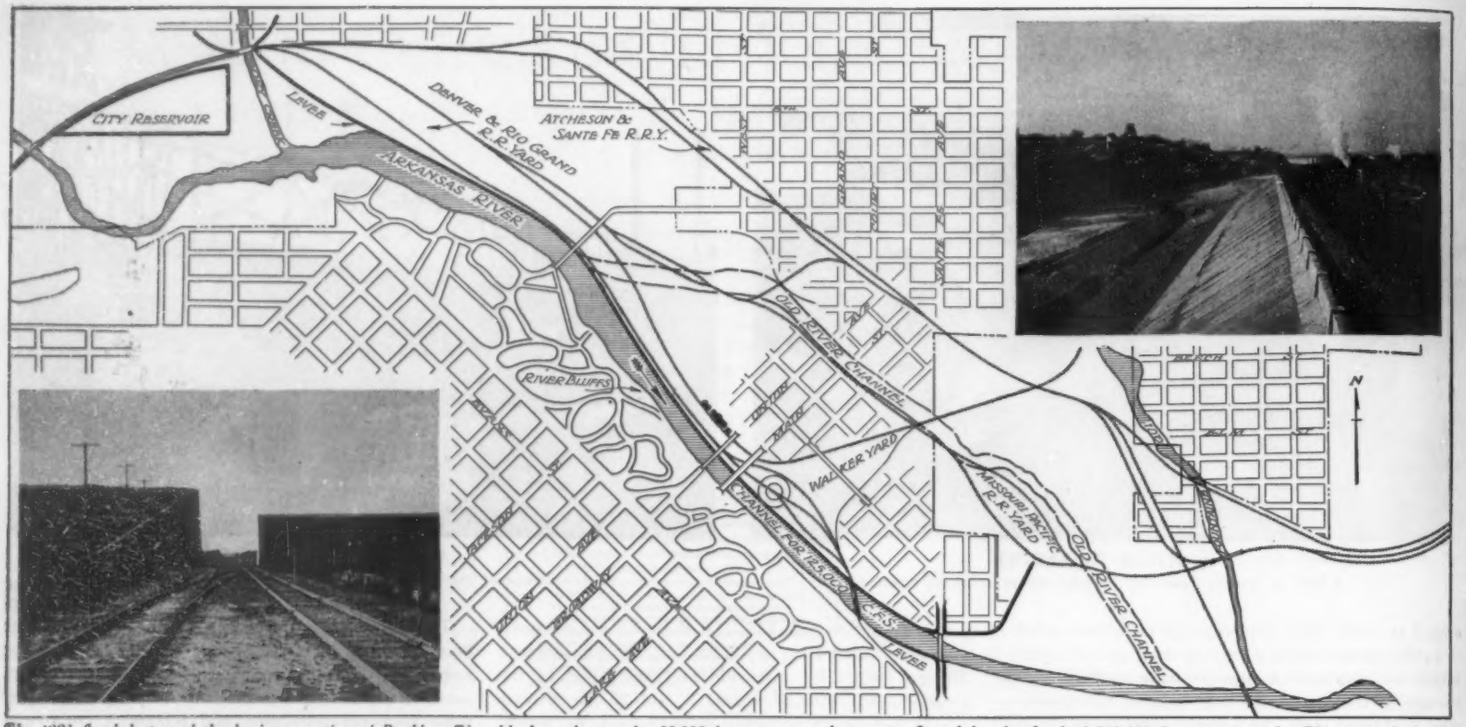
Although wood preservation has made wonderful strides in this country, there yet remains much to be done in spreading the gospel of treated timber.

Today, the preservative treatment of wood is standard practice with many large users of crossties, piles, poles, paving blocks, cross-arms and construction timbers. The field is so broad, however, that it could readily be extended to all other users of such material as well as to many additional classes of wooden commodities. In the erection of any dwelling house, public works or other structure, built wholly or partly of wood, there is some material which it would be advantageous to treat, and through its treatment a real economy would be effected, not only in an actual saving in dollars and cents, but a saving of the timber supply of the nation.

The average life of an untreated crosstie is estimated to be seven and one-half years, while the same tie subjected to pressure treatment will last fifteen years or more. Well treated ties frequently have to be removed on account of wear rather than decay.

Untreated piling on an average fails, from decay or the attack of marine borers in sea water, in from one to four years, and lasts up to a maximum of from 12 to 15 years when used in fresh water or on land. This same class of material when given full pressure treatment with creosote will give from 15 to 30 years' service or even more, depending upon the use to which it is put.

Treated sap-pine posts have been found to be in good condition after 30 to 40 years in the ground. Untreated, they have to be renewed in from two to five years.



The 1921 flood destroyed the business section of Pueblo. The old channel, capacity 38,000 feet per second, was overflowed by the flood of 100,000 feet per second. This map shows the new channel of 150,000 cubic feet per second capacity. LOWER VIEW: *Rock Canyon Barrier.* UPPER VIEW: *Stretch of the new channel*

Western City Ends Flood Menace

Moving a River Half a Mile Across the City of Pueblo

By J. E. Murphy

IF an observer, gifted with prophetic vision, had stood in the midst of the devastated area of Pueblo, Colorado, the day after the flood of June, 1921, and had looked four years into the future, he would scarcely have believed what his vision revealed.

As matters stood then, the city was indeed hard hit, with the heart of its business district wrecked apparently beyond repair. And that was not all. Stretching west to the mountains was the drainage basin of the Arkansas River, a triangle containing 1,800 square miles of mesas and foothills, with steep slopes and impervious soil, subject to the cloudbursts of the mountain country. From the same source would come other floods, greater, perhaps, than the one just past, and in time the disaster was sure to be repeated.

Rebuilding a Wrecked City

But on the fourth anniversary of the flood the same observer would have found the devastated area rebuilt along better lines, with no evidence of the disaster except an occasional high-water mark on some brick building. For, dealing with the peculiar flood situation that has menaced the city from the days of the first settler, he would have found a protection system capable of taking care of the biggest flood the Arkansas can ever send down the valley.

When the engineers came on the ground to work out a system of protection they found a difficult situation to deal with. Their first problem was to determine the greatest flood that could come out of the region west of the city. The next, was to design and build protection that would take care of that flood with a liberal margin of safety.

The valley of the Arkansas cuts through the middle of the city. In this valley lie the greater part of the business district, important terminals of three railroads, and a small residence district. The valley is bounded on the north by gently rising slopes and on the south by the bluffs at the north edge of the section of the city, known as the Mesa.

There is something that appeals, or should appeal, to our sense of the dramatic in the vast and, we had almost said, audacious works by which the civil engineer has met and mastered the floods of the Arkansas which wrought such frightful havoc on the fair city of Pueblo in 1921. Throwing forward, as an outpost to meet any on-coming flood of the future, a massive barrier wall stretching clear across the valley some six miles above the city, he then swung the river over against the bluffs on one side of the city and deepened and widened it until it was capable of taking care of any possible flood and of passing the turbulent waters harmlessly through the city.

The matter of cost made it impracticable to resort to the simplest solution—a channel big enough to deal with any flood that might come.

The key features of the protection which were finally worked out are a channel through the city, capable of carrying a flood one and a half times as great as that of 1921, and a retarding dam, or "barrier," west of the city for cutting down the peak flow of greater floods.

The peak flow of the 1921 flood was slightly less than 100,000 cubic feet per second, or "second-feet," as commonly called, this stage being reached at one o'clock at night.

The old river channel had a capacity of only 38,000 second-feet. There was only one possible result, and for several hours swift currents swept through the streets at a depth of from 9 to 14 feet. The new channel has a capacity of 125,000 second-feet when filled to a depth of 27 feet, and at this depth the velocity of flow will be 23 feet per second.

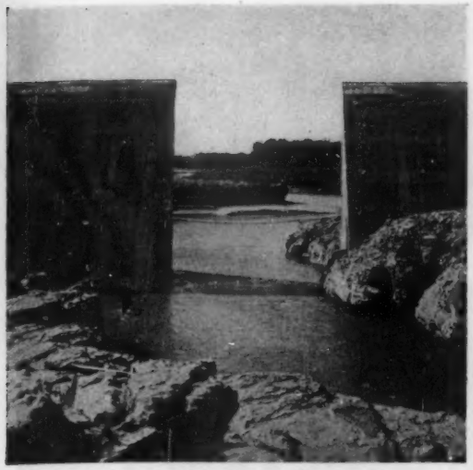
Owing to the liberal freeboard and the extra capacity given by a parapet wall that tops the north bank for a distance of 6,000 feet at the lower end, the channel in an emergency could carry a flood of 150,000 second-feet. But that would be its limit.

How River Was Moved

In their study of the situation the engineers found that the old river channel was not only too small but that it was too crooked and was in the wrong place. Accordingly, the river was moved half a mile across town to a comparatively straight course along the foot of the Mesa bluffs, where an expert city planner would probably have located it in the first place.

The diversion of the river begins 6,000 feet west of Union Avenue, the principal business artery of the city, and extends two and a half miles to a point beyond the easterly city limits.

The important section of the channel from a construction point of view, however, is a mile in length, with Union Avenue near the center. In this section nearly one million cubic yards of excavation was required. East and west of this section the new waterway cuts through wide bottom lands and consists of a low-water channel with levees for confining the flood waters.



BARRIER OPENING TO PASS RIVER

A section of Rock Canyon Barrier, built six miles up the valley above the City of Pueblo, to hold back the crest of the floods. The gap in the concrete wall permits passage of the river

Heavy cutting into the bluffs as well as a cut of 15 feet below the valley floor was necessary in the construction of this central section of the channel, which has an average bottom width of 177 feet and slopes of 1½ to 1. The bluffs form a natural bank on the south side, but on the north bank the cut below the valley floor is supplemented by a levee for completing the channel to the required depth. Channel and levee slopes are continuous and are paved with reinforced concrete.

Before the channel could be constructed, it was necessary to remove a railroad terminal containing 34 miles of track and to construct a new terminal, with main-line connections to the west. The channel is spanned by one railroad bridge and four street bridges.

Rock Canyon, where the barrier is located, is six miles upstream from Pueblo, and here the principal arteries of the drainage basin converge to the river. With the exception of Dry Creek, which comes in from the north near the westerly city limits, only local drainage from six square miles of territory enters the river between Pueblo and the barrier. This is therefore the logical place for checking the larger floods. It is also the natural site for the barrier, because of a flat ridge of sandstone that extends across the valley at an elevation of from 17 to 20 feet above the river bed. With this situation the barrier was half built before construction started.

The barrier is composed of two sections, divided by a double-track railroad line that parallels the river on the south side of the valley. Extending south from a concrete retaining wall at the tracks to high ground at the south side of the valley is the earth section, an embankment 1,540 feet long, 20 feet wide on top, and 35 feet high at the highest point.

North of the tracks is the concrete spillway, which, with one break, extends 1,513 feet to the bluffs on the north side of the valley. In this way an open-top gap 31 feet wide is provided for the tracks.

The spillway is a mass concrete dam 28 feet high with its crest curved transversely. It is designed to be overtopped by a flood. This is not the case with the embankment, the top of which is placed 13 feet higher than the spillway where it is well above any danger of overflow. Where the spillway crosses the river there is an open-top gap 41 feet wide. In addition to the above the barrier is pierced by two minor openings.

In determining the normal capacity of the channel through the city, 100,000 second-feet was allowed for the discharge from the barrier and 25,000 second-feet for a simultaneous flood from Dry Creek.

Checking the Onset of the Flood

If a flood ever reaches the crest of the spillway, the total discharge from all openings will be 100,000 second-feet, with 18,000 acre feet of water backed up in the basin behind the barrier. For this a flood having a peak flow of 145,000 second-feet would be required. It would take 15 hours to fill the basin to the crest of the spillway, while the crest of the flood would pass three and a quarter hours before this stage could be reached. The possibility that a flood will ever overtop the spillway is therefore remote.

Dry Creek has a drainage area of 86 square miles. During the greater part of the year it is a dry wash, but in the flood season it is subject to cloudbursts of the greatest intensity. A few hours before the 1921 flood in the Arkansas this stream sent down a peak flow of 28,000 second-feet.

Four railroad tracks, built in connection with the flood-control work, cross Dry Creek half a mile from its junction with the river. These tracks are below high water level. The bridge at this point is of unusual construction, since it is designed to serve as a railroad bridge, as a means of protecting the tracks against overflow, and in some measure as a barrier for checking floods.

This structure is a reinforced-concrete, girder bridge consisting of five 40-foot spans. The downstream and intermediate girders are each nine feet

BUILDING THE SPILLWAY

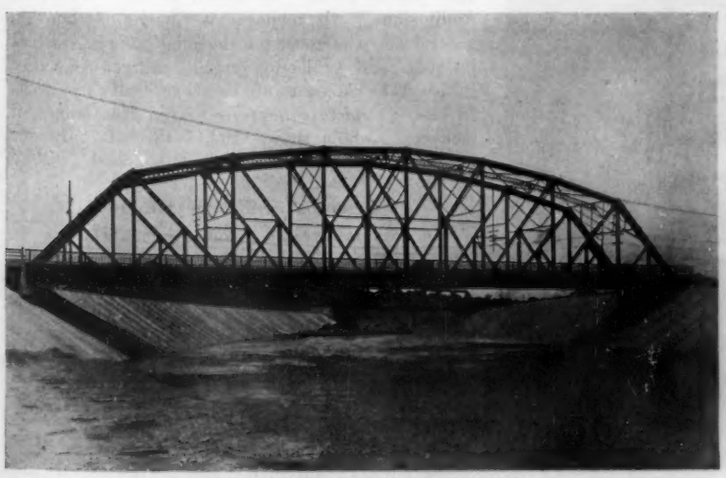
Rock Canyon Spillway extends 1,513 feet from the river to high ground. A massive earth embankment, 1,540 feet long, reaches to the opposite side of the valley. Excessive floods may pass over the spillway

six inches high, while the upstream girder is twelve feet six inches high. This construction not only eliminates the expense of raising the tracks to a line above high water level, but provides for an additional three feet of heading up on the upstream side, with consequent checking of the largest floods. Protection at this point is completed by levees connecting with the abutments.

In the matter of floods, Pueblo is peculiarly situated. The shape of the front range of the Rockies is such that much of the drainage basin lies in a triangular mountain pocket which is 60 miles wide on its eastern and open side and which runs to a point at Canon City, where the Arkansas comes out of the mountains. Storm clouds from the east are sometimes driven and piled in dense masses into this pocket. Whenever this process continues long enough the result is a series of cloudbursts.

Owing to the intensity of the rainfall and the steep slopes of the country the resulting flood, although usually of short duration, is destructive because of its high peak flow. All these conditions were present in the flood of 1921.

By their mutual action the various control structures will protect the city against a flood with a peak flow 80 percent greater than that of 1921 and two and a half times as great as that flood in volume. After a careful study of the flood possibilities of the drainage basin, this amount of protection was determined upon as ample, but not excessive.



STEEL BRIDGE OVER NEW CHANNEL

Santa Fe Avenue Bridge over the new channel of the Arkansas, with railroad bridge beyond. The channel is capable of carrying a flood one and one-half times as big as that of 1921

CONCRETE RAILROAD BRIDGE

The bridge built to carry railroad tracks over Dry Creek (see upper left hand of map). It serves also as an effective barrier to hold back the crest of heavy floods

OUR TOILERS UNDER THE GROUND

Some of the two hundred mine workers who gather during their noon-hour in the underground "movie palace"

An Underground Moving Picture Theatre

A Novel Method of Providing Entertainment and Instruction for Miners and Their Families

By James H. Collins

THIS theatre has no thrilling posters in the lobby, no beautiful marcelled blonde in the box office, no tabloid opera, vaudeville, ushers, upholstered seats or orchestra—although two men in the audience did volunteer music when the theatre was opened some months ago, and furnished an overture on their accordions.

Yet this movie house does a profitable business, and probably puts on the "deepest" show in the world, being 250 feet underground, on the second level of the Spruce Iron Mine, at Eveleth, Minnesota. It has a seating capacity of 200; and it puts on regular noon-hour shows about every other week.

Safety-first Methods Taught

Several years ago, the Oliver Iron Mining Company began showing accident-prevention films to its employees, who are scattered over miles of country. Here they work underground, there on the surface, and in other places mining is done by the open pit method. All sorts of schemes were devised to make the exhibitions attractive and convenient to employees. Pretty nearly every nook and corner where a projecting machine and a screen could be set up was used as an improvised theatre. Sometimes the audience was assembled in an eating house, sometimes in one of the "change houses" where the men wash up after coming above ground, and sometimes in a garage, machine shop or wherever it was dark enough to give the show, and employees could sit down on improvised seats. The "safety first" movie flitted around like a will-o'-the-wisp, here today, gone tomorrow, like the circus. But, wherever it went, it was popular with the miners and their families.

At the Spruce Mine, there was an abandoned room formerly used for a pumping station. The miners suggested turning this space into a theatre so that the pictures could be seen during their lunch hour without the necessity of going above ground. The room was fitted with rough benches, projecting machines, silver screen, electric lights, and ice water; and immediately it began drawing the biggest possible audiences, because everybody working in those diggings attended the movie show.

THE "WILSONIAN AUDITORIUM"

This small theatre is equipped with rough benches, projecting machines, silver screen, electric lights and even ice water

Pictures are shown at noon, and the company goes fifty-fifty on the time needed to see them—that is, the company contributes so many minutes of working time for which the men are paid, and the men contribute an equal number from their lunch time. The "movie palace" is known as the "Wilsonian Auditorium." Its manager is Charles Grabowsky, general superintendent of the mine, and the actual program and projection are in charge of Walter Ethier. The programs are short, generally two reels. In case the picture happens to run that length, it makes the whole show. But if there is only one reel, a comedy or educational reel is added.

Lessons for Future Miners

The show is repeated at other mines, and also at places on the surface where employees' families can see it. In this way the youngsters learn safety mining methods early in life. Both below and above ground, the program is made up to entertain as well as teach. No matter how attractively it may be dramatized, a safety lesson in picture form is none the less a lesson. On that account, extra reels of pure entertainment are added, and frequently they are comedy reels.

The novelty, convenience and interest of this picture theatre have been a factor in reducing accidents and safeguarding property.

Two gargoyles in place on the wall

Fossils in Architecture

A new note in architecture is marked by the decorations attached to the geological building recently completed at Washington University, St. Louis, as illustrated on this page. Under the direction of Professor Walter E. McCourt, head of the Department of Geology at that University, the familiar designs of devils and mythological beasts commonly used for decorative gargoyles have been replaced by sculptured reproductions of some of the ancient beasts which really lived on earth in remote geologic times. Thus artistic fitness and geologic interest are alike attained; and surely, from a standpoint of grotesqueness, these extinct creatures leave nothing to be desired.

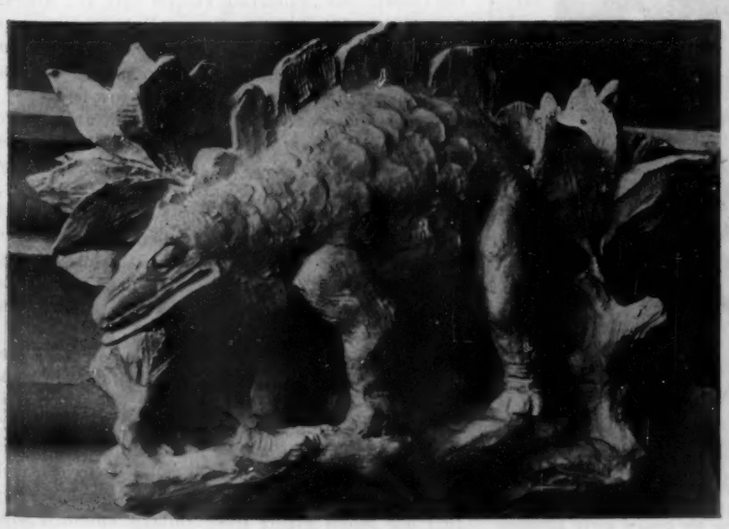
An ancient flying reptile, or pterodactyle

The Megatherium, one of the giant extinct sloths

Below, to the left, is the Stegosaurus, one of the great armored dinosaurs common during the Age of Reptiles. Below, at the right, is the Tylosaurus, a fish-like reptile which once swam in the ancient seas. Above are the models of the pterodactyle and the Ceratosaurus, as they are attached to the building

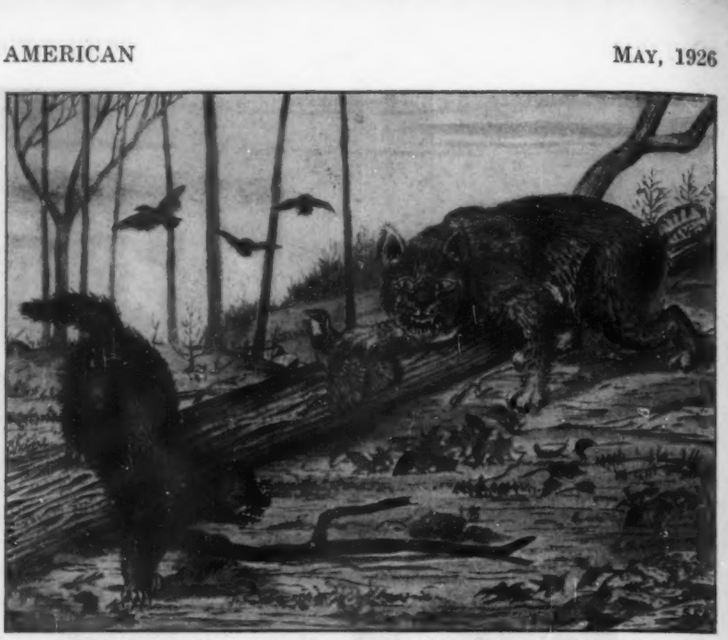
Phorohacos, an extinct giant bird of Patagonia

The Ceratosaurus, a horned, flesh-eating dinosaur



MOLLY COTTONTAIL TURNS TO THE BRIAR PATCH

Here she will scrape off the attacking weasel. Seldom are powerful, fleet-footed and alert rabbits overcome by the bloodthirsty little killers



THE PEKAN AND THE BAY LYNX OBSERVE FOREST ETIQUETTE

The lynx's possession of his prey is respected by the equally powerful pekan. Had the pekan first made the capture the lynx would have retired

Nature Faking

Popular Fallacies Have Grown Out of Pseudo-Scientific Nature Lore

By S. F. Aaron

Drawings by the Author

WHEN the late Theodore Roosevelt directed a well-aimed and perfectly logical blow at "nature faking," he rendered to popular natural science one of the most distinct services. But this sort of warfare must be continued; for the nature fakers still exist in growing numbers. The Colonel's attack upon an ill-informed writer of many books, who has since spread himself even more disastrously, is now a matter of history; it is admittedly a well-set example for popular scientists and nature students who possess a genuine interest in educational advancement.

Sensationalism seems to be so much the order and practice of the day in literature that, notwithstanding the extension of scientific research, there are some who give the impression of trying to emulate Baron Munchausen in his extravagant tales.

Scientists and Naturalists to Blame

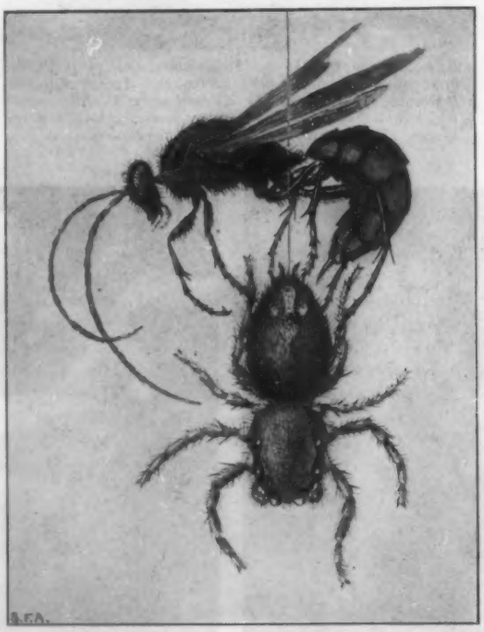
There always has been and probably there always will be that very human tendency toward imagination which is one of the characteristics that lift the human species into civilization and drop it into error. Even scientists fall victims to it in their eagerness to erect hypotheses; and they almost unknowingly broadcast it in minor things. The trained naturalists are most to blame, since they are seekers after truth and find nature sufficiently wonderful and expressive to forbid supposition or make-believe.

Burroughs did much in his day to upset the false ideas of the *literati* respecting simple facts in natural history. He discovered vast errors in the work of the poets, and even assailed Thoreau, from whom one would hardly have expected error, since it was he who claimed that he "could tell the hour and the day of the month by the appearance of certain plants." Such a claim is about as fancifully absurd as any exaggeration could be, when one considers that as much as two weeks may pass between the sprouting and blossoming of any species, and that there is much difference in the unfolding or closing of flowers on sunshiny and on murky days.

But Burroughs himself, through faulty observation and almost blamelessly, drifted into palpable errors.

The author of "Birds and Seasons" showed marked disapproval of the less exuberant fakers of the last generation. Hamilton Gibson threw several bricks into the camps of those who expressed a growing tendency to tell what they did not know, and himself became involved in several statements, especially one regarding the bagpipes of tree frogs and toads, which he pictured not merely as swellings in their throats but as great membranous bubbles extending out of their mouths.

Even the great Fabre, who has been more lauded and quoted than any other nature writer of a foreign country, could not refrain from errors due to supposition and incomplete observation, one of which—namely, the intended puncture of the central ganglia of spiders by the captor wasp for the purpose of paralyzing—has been shown to be a fallacy.



DIGGER WASP AND JUMPING SPIDER

Wherever the sting is given the spider instantly succumbs. There is no need of reaching the central nerve ganglion

These cases, however, in which the carefully investigating naturalists are remiss, come from closely related facts and are not born entirely of the desire to relate wonders and unheard-of things. It is the writers of books designed to be "best sellers" and the contributors to periodicals that prefer high-sounding phrases and startling episodes who force upon unsuspecting readers lamentably absurd errors, regarding the habits and habitats of animals.

A Perusal of Text-books Would Help

Thus, we read (and to this I have before demanded attention, though it cannot be too often driven home) of tigers being hunted in Africa, and of jaguars and boa-constrictors blundering around Asia and Africa. Any child who can remember a little of his geography lessons should know better than this; and is it not strange that the caterers to public taste in print do not first peruse some simple text-books?

Thus, we are asked to go afield with an admirer of butterflies, who at least deserves a reading because he has seen in the wings of the Lepidoptera, beauty that rivals gems and flowers. But, unfortunately, in one blossoming meadow he finds a dozen species that inhabit only very widely separated areas over our broad land. So, we must suspect him of being guilty of letting loose an assortment of the insects from every point of the compass before he begins to note them!

Not content with such errors as the foregoing, the emulators of certain naturalists who, to begin with, were deplorably given to relating unsubstantiated and unnatural things, have, with as little reason and learning as is shown in their ignorance of geographic distribution, most ridiculously allotted to some of our commonest and better known creatures behavior that one might expect from animals endowed with

human intelligence and almost unlimited strength.

And so we read of a puma, with uncanny precision, leaping out and down thirty feet upon an unsuspecting deer and breaking "nearly every bone in its body"—the deer's body, of course. Some jar that! Being hit with an express train would hardly match it. We read of a python striking and killing a boy with a blow of its tail. Such an incident, unless the lad were scared to death, could happen no more easily than he could be killed by being hit with a sack of oats. We read of a sheep-killing dog that raised a window to get out on a night hunt and, returning, shut the window after him, a thing which no dog, however intelligent, has the brains to do. It simply is not within his understanding.

We read of a weasel in the ermine's coat of the "white assassin" seizing a grouse under its beating wing, one blow of which, in reality, would send the weasel topsy-turvy; of his chasing rabbits, with the foregone conclusion that Bunny is as good as dead if he persists; of his going down a tree, across to and up another in the same time during which a red squirrel would leap from one branch to another; of his forcing the squirrel to the ground and then catching it. All of this is entirely fanciful.

This sort of thing, however, may in a measure be excused, if the author has perused "Wild Animals of North America," published by the National Geographic Society, in which the statement is made that rabbits fall an easy prey to weasels. Such is not the case. Molly Cottontail can as easily outrun a weasel as a greyhound can distance a dachshund; and she is too strong to be easily held.

Some Myths Exploded

There are on record cases of rabbits being seized in "the squat" by the stalking weasel and then breaking away. I have witnessed two such instances. In one case a rabbit more than half grown had been cornered in a woodchuck hole by a large stoat. By prodigious leaps, dashes through briars and final kicks, the stoat was shaken loose; and instantly, knowing the futility of pursuit, it gave up the chase. Moreover, weasels cannot overtake red squirrels on the ground. I have seen several such pursuits, one leading along fences, through piles of brush and over logs. Neither animal gained an inch until the squirrel went up a tree; and then the weasel was hopelessly left behind and went off on other business.

The impression has also been conveyed to the uninitiated that rabbits are frightened into a comparative state of helplessness by the mere approach of a weasel, as though the weasel possessed some sort of hypnotic power. This is also suggested in a book and in several other references by a well-known and popular naturalist. There is no more truth in this assumption than in the traditional notion of snakes charming birds and small quadrupeds.

Burroughs' story of the red squirrel that went into a tree and then left it to go into rocks, followed presently by a weasel is, to my mind, not worthy of belief. He got it from another and should not have been so credulous as to quote it. In the experience of every naturalist, hearsay evidence too often proves unsound; like some fish stories, such statements are not untruths, but exaggerations or mistaken impressions. Often, too, they are direct untruths. If one would write a natural history based only on hearsay, Dean Swift or Verne would be outdone.

Burroughs also seems to half credit yarns of birds being charmed by snakes, though asserting that "there is probably little truth in the popular notion." There is, indeed, so little truth as to make it appear almost unworthy of denial. Yet these notions have become traditional, either as merely related incidents or as pointing a moral. But in every case they result from imperfect observation, exaggeration, or both. In every instance, the supposedly charmed creature is wrought with fear for its young and itself or its mate and is struggling with indecision as to whether to attack or retreat from an insidious foe. It seems altogether impossible to credit the idea of the near-victim's becoming faint or comatose when rescued.

In the case of the partridge and snake, as told to Burroughs, the bird was merely incapable of sustained flight and sank down after the ordeal from mere exhaustion. Burroughs' own experiences are quite different; witnessed by such a competent observer, no evidence of hypnotic power is seen. Indeed, as with the rabbit and weasel, nature has not developed fear to the extent of endangering her creatures, but to give them greater powers of self-protection. Otherwise, all the rabbits would quickly fall victims to weasels and all the birds, to snakes.

I have many times placed sparrows and mice, and once a chipmunk, in cages with snakes, to test this

SPARROWS FIGHT A SNAKE

This picture illustrates Burrough's account of such an incident. The birds easily keep out of the reptile's reach and valiantly attack it. They are by no means charmed

"charming" story. There was opportunity for the supposed victims and the victimizers to approach or retreat. In no case was there even fear shown on the part of the former until the latter attempted to make a capture, which was always by means of the chase, or a sudden opportune strike. Quite often the birds and mice, in search of food, hopped upon the body of the snake, encountering its glaring eyes without so much as noticing them; and the birds easily avoided the snake's efforts to capture them. The chipmunk, when seized, bit the head of the black snake so severely as to effect escape and shortly to cause the death of the reptile.

I think it is seldom that well-grown rabbits, squirrels and adult birds are captured by snakes; nor is it quite possible to accept as good natural history the dead thrasher in the loose coils of the snake in Audubon's famous picture. I have seen both thrashers and mocking birds, a pair of each, without other aid very decidedly defeat black snakes, although evidently doing the snakes very little harm; and I have seen also a lone meadowlark kill a large garter snake that threatened her nest of young. Burroughs' description, from his own experience, of the song sparrows fighting a snake in defense of their young, is the most delightfully presented evidence of what actually occurs between snakes and birds in close contact.

Yarns which are all too common and which are made much of by the sensation-mongers are those of fights to the death between wild animals upon every conceivable occasion. One very popular book, delightfully written with regard to its poetic sympathy with the wilds and the ancient forests, and other stories by the same author, make head-liners, as it were, of these acts; and it is a favorite theme with beginners in magazine nature-stuff.

After long experience, this statement of fact seems worthy of repetition: Aside from occasional battles over doubly claimed victims—which quarrels are settled very quickly—and the sometimes, though seldom, prolonged scraps of rival and amorous males, all mammals and birds recognize inferiors and superiors of their own or other species and attack or give way often without further parley. Moreover, there is among wild animals—feathered or furred—little of the bulldog or game-cock tenacity which has been bred into these domestic creatures by man. Nature demands at all times survival, and she seeks invariably the course of least resistance.

Emotions and Sentiments Exaggerated

Thus, as between species, bears quietly dominate all other creatures. Even the lordly moose and stag wapiti, when alone, acknowledge his superiority. On the other hand, Bruin does not encroach upon the moose or elk herds. Wildcats respect the pekan, and the latter keeps clear of the wildcat; the two species of lynx, where their habitats overlap, dodge each other with positive certainty; and it is the same way with the fox and the mink and all other creatures with regard to the otter. Even the puma is a diplomat—in many respects a coward. He shows the same caution toward other enemies—the lynx, pekan, otter and wolverine—as toward man and his dog.

The mountains, vales and prairies are so large that there is no necessity for fighting over a few yards of lair or a nesting place; and when a quarry is brought down there is, in nearly all mammals, a certain and very positive respect for the possessor. Birds do not show this so much; they are eager snatchers, quarreling, but seldom actually fighting, over the choicest morsels.

Perhaps the most common and really inexcusable errors that lend themselves very naturally to nature faking are those which combine with suppositions respecting animal intelligence. They have had birth in Aesop's "Fables" or in "Reynard, the Fox"; in this day they have their biggest boost in certain very popular biographies. But, to the closely investigating nature student who may justly believe in animals thinking and reasoning within their experience and hereditary understanding, the idea that their sentiments and emotions are akin to those of man is in a serious sense distasteful.

Aside from mother love, the mating instinct, which is carried far enough to show a degree of unselfishness in the male, and the gregarious instinct, which extends to the choice of a single companion—more rarely of another species—nothing of loving choice, sentimental consideration nor positive generosity is demonstrated by animals. The homing instinct is merely a desire to get back to familiar hunting and resting places; but the roving tendency often proves as strong, governed by the search for food or a mate, since these two urges are the dominant influences among all creatures, from the gnat to the elephant.

From the Scrap-book of Science—Camera

Wide World

REPTILE CAUGHT EVOLVING

The fossils of Seymouria, an extinct reptile of the Permian Period, 75,000,000 years ago. This highly significant fossil, which shows many characteristics of the amphibian from which it was evolving, is at the University of Chicago

Wide World

REMARKABLE CATERPILLAR RECENTLY FOUND IN BRAZIL

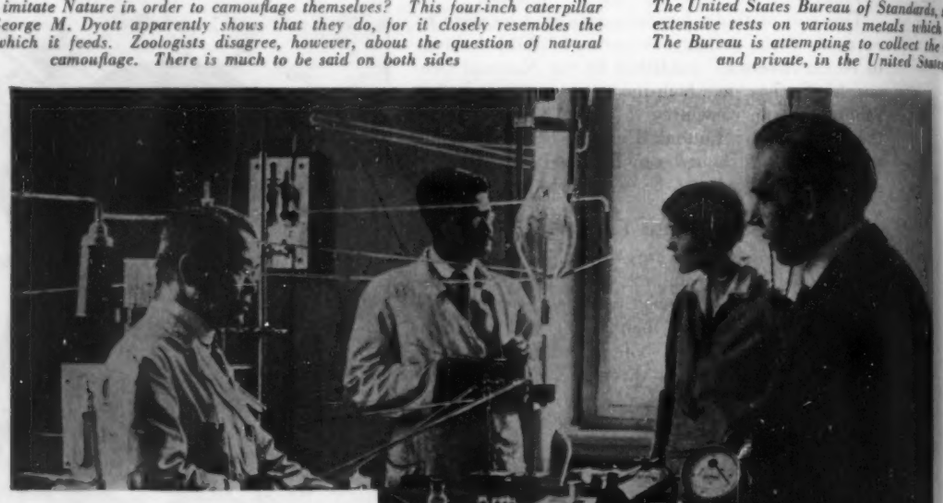
Do animals imitate Nature in order to camouflage themselves? This four-inch caterpillar found by George M. Dyott apparently shows that they do, for it closely resembles the plants on which it feeds. Zoologists disagree, however, about the question of natural camouflage. There is much to be said on both sides

Keystone

TESTING MOTOR CAR PARTS AT THE BUREA

The United States Bureau of Standards, situated at Washi extensive tests on various metals which enter into the c The Bureau is attempting to collect the names of all the and private, in the United States, and would app

Keystone



Keystone

THE SUN-VALVE LIGHTHOUSE

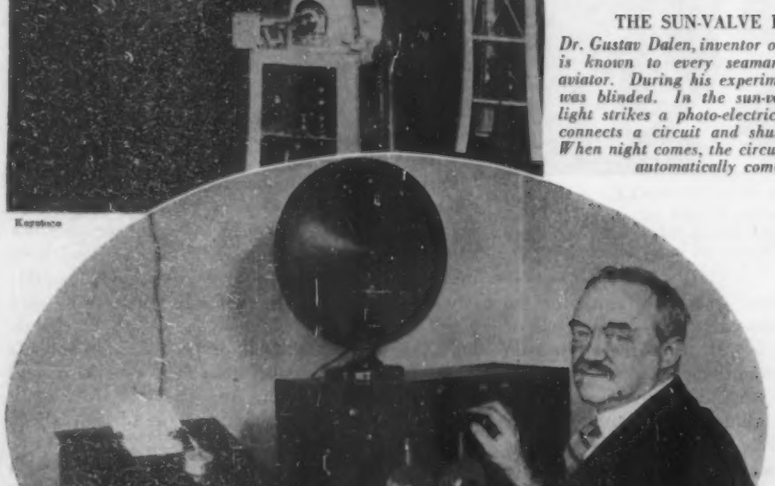
Dr. Gustav Dalen, inventor of the Aga light, which is known to every seaman, railroad man and aviator. During his experimental work Dr. Dalen was blinded. In the sun-valve light, when sunlight strikes a photo-electric cell it automatically connects a circuit and shuts off the lighthouse. When night comes, the circuit opens and the light automatically comes on again

NOTED ATOMIC PHYSICIST IS NOBEL PRIZE WINNER

To study under Prof. Neils Bohr, the famous Danish physicist, scientists come from all over the world. Out of several competing theories of the inside of the atom, Bohr's theory has now been virtually accepted. Few young men have received so much deserved fame

Wide World

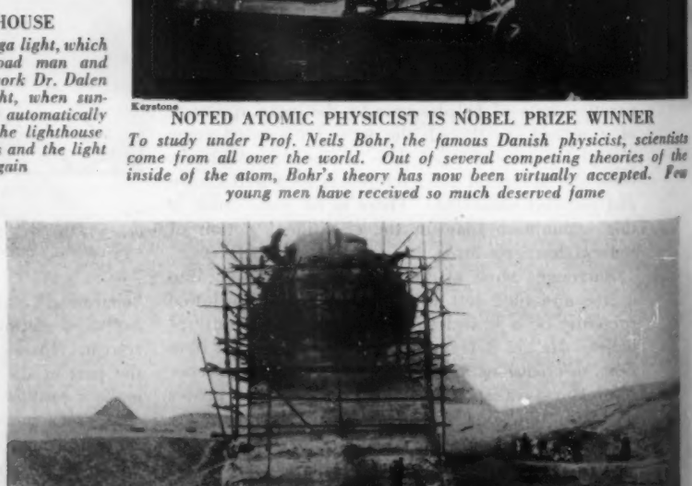
In summer, in fall they ferment.



Pacific & Atlantic

RADIO PEN BROADCASTS PICTURES

C. Francis Jenkins, Washington radio inventor, has just completed an apparatus which sends maps or pictures through the ether. The receiver used works with any tube set, in place of the loudspeaker



Keystone

RENOVATING THE SPHINX

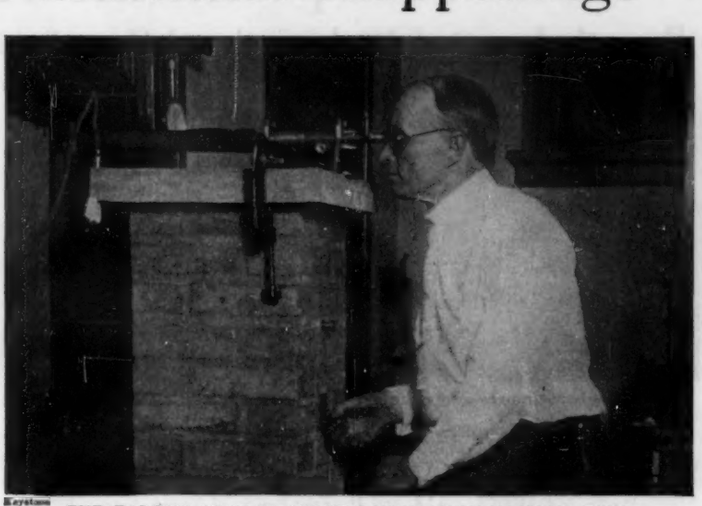
In order to offset the effects of time and the elements the Egyptian Government has been furbishing up the Sphinx. Parts of the head in danger of disintegrating were braced

Keystone

In Saipan, evidence t

Camera Shots of Scientific Happenings

RTS AT THE BUREAU OF STANDARDS
ards, situated at Washington, D. C., is conducting which enter into the construction of motor cars. t the names of all the testing laboratories, public States, and would appreciate information



Keystone

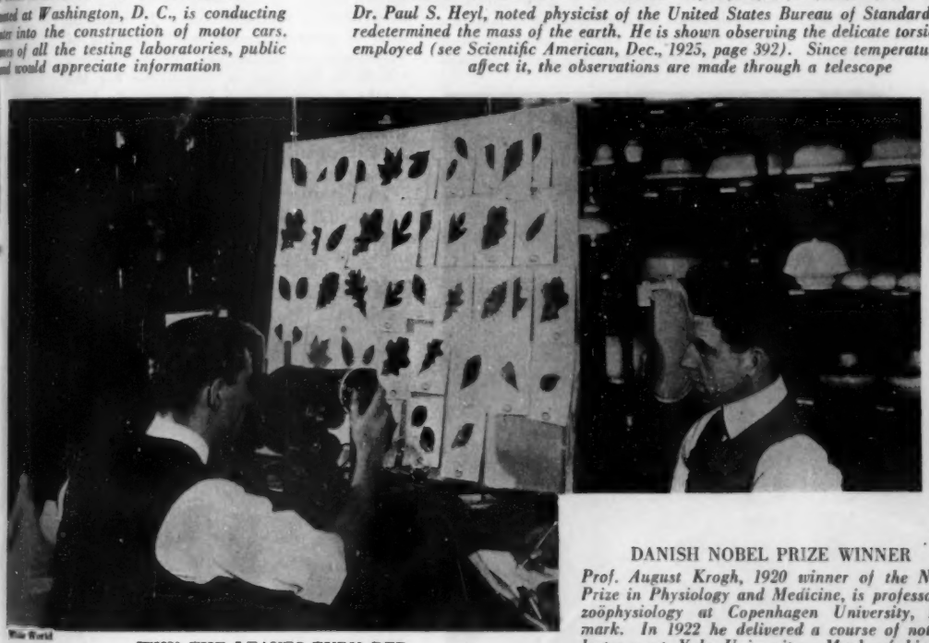
THE EARTH'S MASS IS ABOUT 5,000,000,000,000,000,000,000 TONS

Dr. Paul S. Heyl, noted physicist of the United States Bureau of Standards, recently redetermined the mass of the earth. He is shown observing the delicate torsion balance employed (see Scientific American, Dec., 1925, page 392). Since temperature changes affect it, the observations are made through a telescope

Wide World

FIGHTING THE DOG'S WORST ENEMY

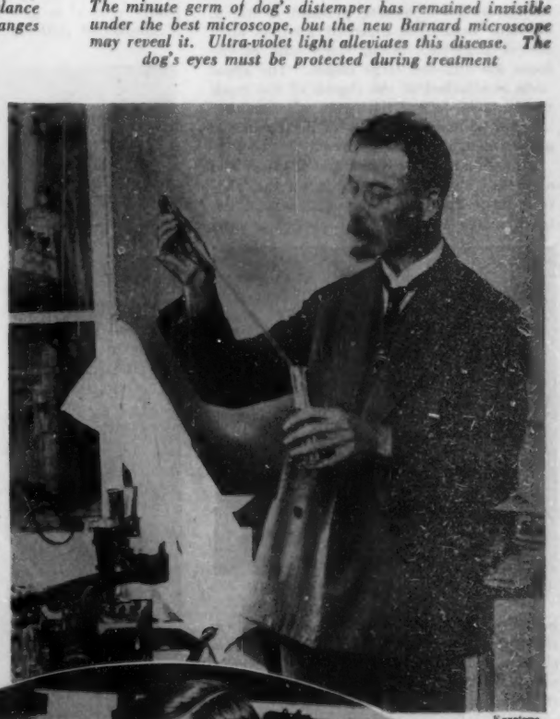
The minute germ of dog's distemper has remained invisible under the best microscope, but the new Barnard microscope may reveal it. Ultra-violet light alleviates this disease. The dog's eyes must be protected during treatment



Wide World

WHY THE LEAVES TURN RED

In summer, the leaves of trees absorb ninety percent of the sunlight; but in fall they shut most of it out. Growth is then retarded and the leaves ferment. Complicated alcohols form and absorb the green chlorophyl of the leaf. This brings out the red and yellow pigments



Keystone

DANISH NOBEL PRIZE WINNER

Prof. August Krogh, 1920 winner of the Nobel Prize in Physiology and Medicine, is professor of zoöphysiology at Copenhagen University, Denmark. In 1922 he delivered a course of notable lectures at Yale University. Much of his life work has been in biochemistry, a science which many anticipate will finally solve that greatest of biological problems—what is life?

Keystone

EXCAVATING ON MYSTERIOUS PACIFIC ISLAND

In Saipan, one of the Mariana Islands, Prof. Herbert E. Gregory of Yale, has unearthed evidence that its former inhabitants were related to an ancient population of northern Japan

Keystone

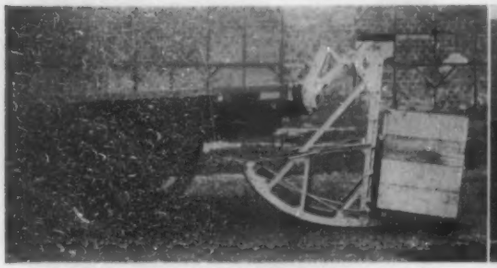
DEVICE MEASURES TEMPERATURE ON MARS

Dr. W. W. Coblentz, of the United States Bureau of Standards, with the electric thermocouple by means of which he found the temperature on Mars to be like that of a cool day on earth

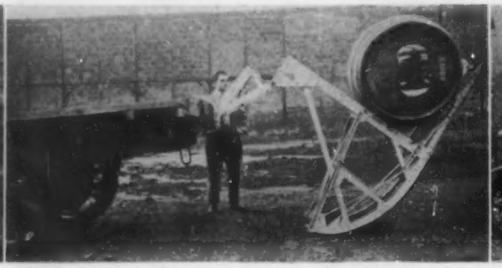
Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

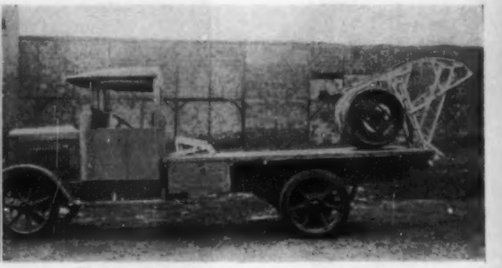
Conducted by Albert A. Hopkins



Loading a heavy case without crane or tackle



When the truck moves away, the barrel is hoisted



The loading device swings out of the way

A French Truck-loading Device

TO overcome the difficulty of loading motor-trucks with heavy objects when no cranes or tackle are available, is the object of an apparatus perfected by a French inventor, M. Biblis of Bayonne, France. This device consists of a metal platform to which, at right angles, is attached another open curved platform. Along each side of the latter are attached large treads. The apparatus is attached to the chassis of the truck by an axle joint. There is also another movable joint in the arms of the apparatus a short distance from the truck.

The operation is exceedingly simple. The object to be loaded is placed on the platform as it rests on the ground. Then the truck moves away, and the apparatus held back by the treads raises the load. When the apparatus reaches its highest point, a slightly inclined plane is formed to the floor of the truck and the load moves onto the truck by virtue of its own weight. If the object is rectangular, a wooden platform is inserted between it and the apparatus so that it will slide on more easily.

Indicating the jointed spout

New Oil Can Spout

A NEW idea in spouts is embodied in an oiler that has recently been put on the market. About an inch from the fount is a joint in the spout, which enables the user to bend it at any angle necessary and still deliver a full stream of oil. Its greatest utility is in oiling parts that are not accessible to the common oiler, which must be nearly vertical to give a full amount of oil. A number of different sizes are available.

A Glass Substitute That Can Be Bent

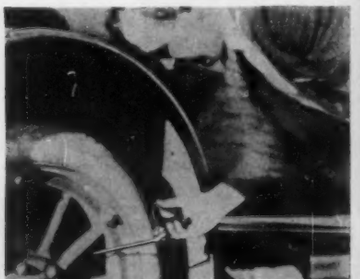
MR. J. C. VREDENBURG, of England, and Dr. Fritz Pollak, of Vienna, have succeeded in inventing a glass substitute that will bend. Real glass, made of minerals, breaks very easily. The new glass substitute is made of organic materials and is as transparent as ordinary glass. It can be bent and shaped. It breaks, but it has no sharp edges. Flames will not burn it; and it bounces higher than the ordinary golf ball when it is thrown down. It may be colored with the most delicate vegetable dyes. It could be used to great advantage in the making of windshields for automobiles, instead of glass which, in breaking, is responsible for the deaths of many people in automobile accidents. Mr. Vredenburg is shown demonstrating the bending qualities of the new glass substitute.

This glass substitute can be bent but it does not break

A Chain Saw for Lumbering

A SHORT time ago we published a photograph of two men sawing down a large tree; and at that time we called attention to the fact that the work of tree-cutting seemed to offer a field for invention. As a result we received two lots of photographs, showing two distinct methods of tree felling—one operated manually and one by power. We have already published the former.

The power for the chain-saw shown in these photographs is derived from an engine by means of a shaft. The saw offers a rigid front to the tree, pressing the cutting surfaces in rotation; but it is thoroughly flexible in the reverse direction.

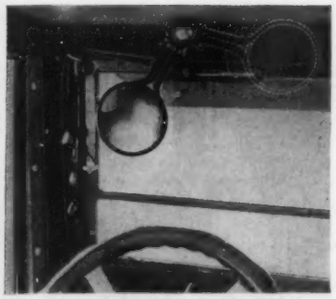


Difficult oiling becomes easy

A chain saw that cuts down trees

A chain saw as a cross-cut saw

Some of the sections cut by the chain saw



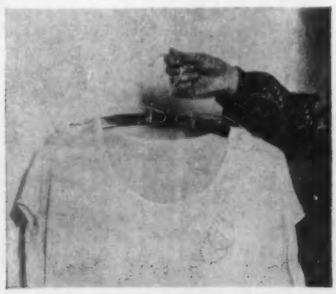
A glare shield and rear-view mirror

A Transparent Mirror

THIS device is a transparent mirror which serves a double purpose. It not only gives protection from glare, but it is also a perfect rear-view mirror. Oncoming glaring headlights are not hidden, but the glare is completely eliminated. The driver does not look through the mirror continuously, but keeps it between the glaring lights and his eyes. As he drives he looks to the right of it. This arrangement makes driving against the dazzling sunlight also much more agreeable. When not in use it is swung up out of the way.

Dress Hanger Prevents Falling of Delicate Garments

THIN dresses and negligees are likely to slip from the ordinary garment hanger to the floor. This is prevented in a recently



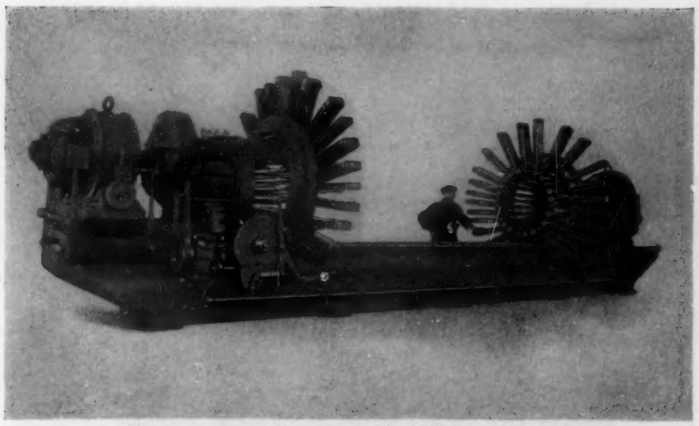
Dress hanger for thin dresses

patented hanger shown in our illustration. Arms of nickeled-steel wire, padded with felt, clamp the dress securely to the hanger until it is released by the lifting of the springs.

A Safe Addition to the Playground

ALL children like to climb; and in municipal playgrounds climbing equipment is often very elaborate. Of more modest proportions is the device shown which could grace almost any children's playground, no matter how small. It is made entirely of pipe so there are no projections to tear the hands or clothing. Many schools have provided one of these "pipe trees," and they answer the purpose admirably. They are unbreakable and will last a long time.

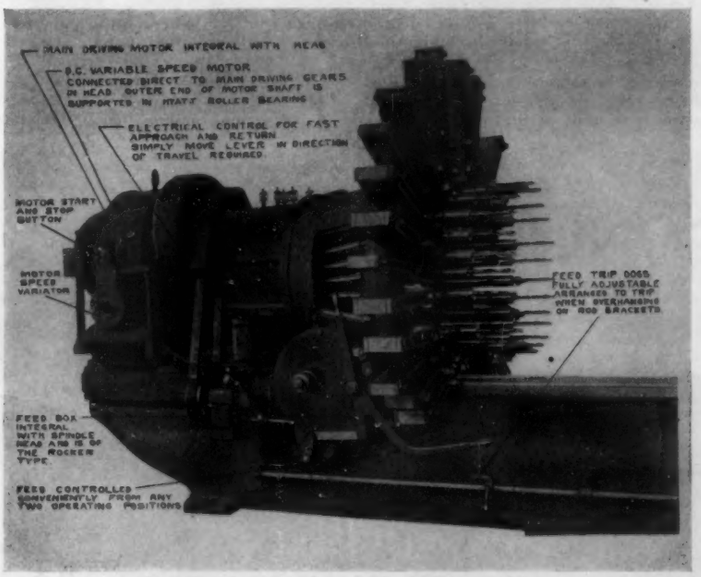
Playground tree for children



There are twenty-four one-inch drills in each head

A Curious Looking Machine Tool

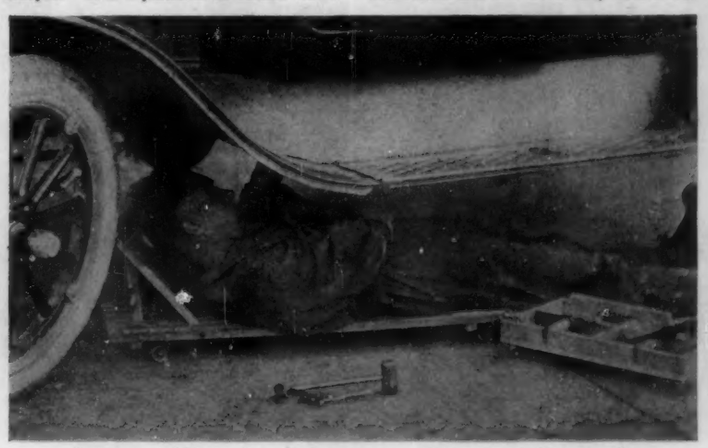
THIS machine is known as a horizontal multiple-drilling machine. The machine, as illustrated in the photograph, has a capacity of 24 one-inch drills in each head, lifts the person off the ground. The one shown has a headrest giving three positions.


MAIN DRIVING MOTOR INTEGRAL WITH HEAD
D.C. VARIABLE SPEED MOTOR CONNECTED DIRECT TO MAIN DRIVING GEARS IN HEAD. OUTER END OF MOTOR SHAFT IS SUPPORTED IN HEAVY ROLLER BEARING
ELECTRICAL CONTROL FOR FAST APPROACH AND RETURN SIMPLY MOVE LEVER IN DIRECTION OF TRAVEL REQUIRED
MOTOR START AND STOP BUTTON
MOTOR SPEED VARIATOR
FEED TRIP DOGS FULLY ADJUSTABLE ARRANGED TO TRIP WHEN OVERHANGING ON ROD BRACKETS
FEED BOX INTEGRAL WITH SPINDLE HEAD AND IS OF THE ROCKER TYPE
FEED CONTROLLED CONVENIENTLY FROM ANY TWO OPERATING POSITIONS

Detail of horizontal multiple-drilling machine

The Mechanic Under the Auto

AN automobile is apt to have trouble in its inaccessible underworks at the wrong time; and the professional or amateur mechanic may be often seen ingloriously recumbent under the machine. Now a clever inventor has devised what he calls a "creeper." It is a platform on casters which so that at one setting 48 one-inch holes can be drilled through cast iron at the rate of three inches per minute. The weight of the machine is approximately 18 tons; and it is driven by two 27 horsepower variable speed motors, attached directly to each head. The heads are equipped with fast approach and return and are electrically controlled.



A creeper which makes getting underneath an automobile simple

Expanding bottle stoppers

A machine of this type is particularly adapted to the drilling of pipe fittings and in kindred industries and can be used to great advantage in locomotive shops. It is the largest machine of its type ever built.

Save the Fizz!

NOTHING is more exasperating, upon opening a bottle of liquid which should effervesce, than to find that the gas has seeped out through the cork or under the crown seal. With the stoppers shown, a turn of the hand expands the rubber band so that the gas is prevented from escaping around the edges.

A Clean-cut Can Opener

THIS can opener is equipped with a pair of cutting wheels in lieu of the usual opening blade. The wheels make a perfectly clean cut in removing the cover of a can. The cover works on the same principle that is employed for shearing metal in factories where large quantities of metal must be cut perfectly. Either of the two cutting wheels may be used by reversing the cutter.

A can opener making a clean cut

Doing Away with the Old-time Wash Tub

HERE is a new wrinkle for the laundry. The laundry tub is made of aluminum and revolves. The saving of labor and time is obvious. As each operation is completed, the tub is revolved to allow of rinsing, et cetera. Hot and cold water are supplied by a rotating spigot.

Novel revolving laundry tub

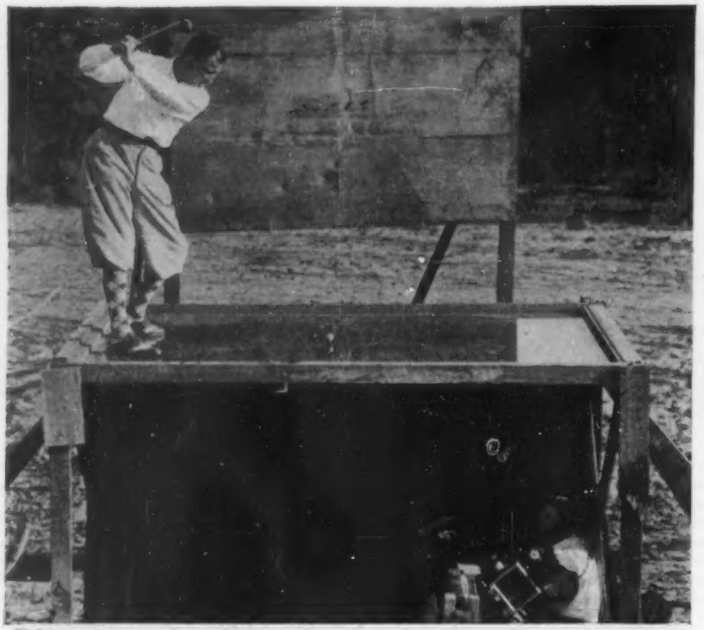
An earnest young author

A Useful Toy

OUR two photographs show a play work-desk which encourages children to write or draw. Beneath the drawing board is a box for paper, pencils, crayons, et cetera. Books rest on the desk at the correct angle for reading. It cannot tip over because of the spread of the legs.

Golf Strokes for the Screen

A FAMOUS golf player is shown driving from a piece of plate glass three-quarters of an inch thick, attached to a frame seven feet from the ground. The camera can be seen under the glass, focused directly up at the golf player. Ultra-rapid movies were made by this method.



Taking pictures of a golf drive through a glass plate. The resulting pictures have been shown all over the United States

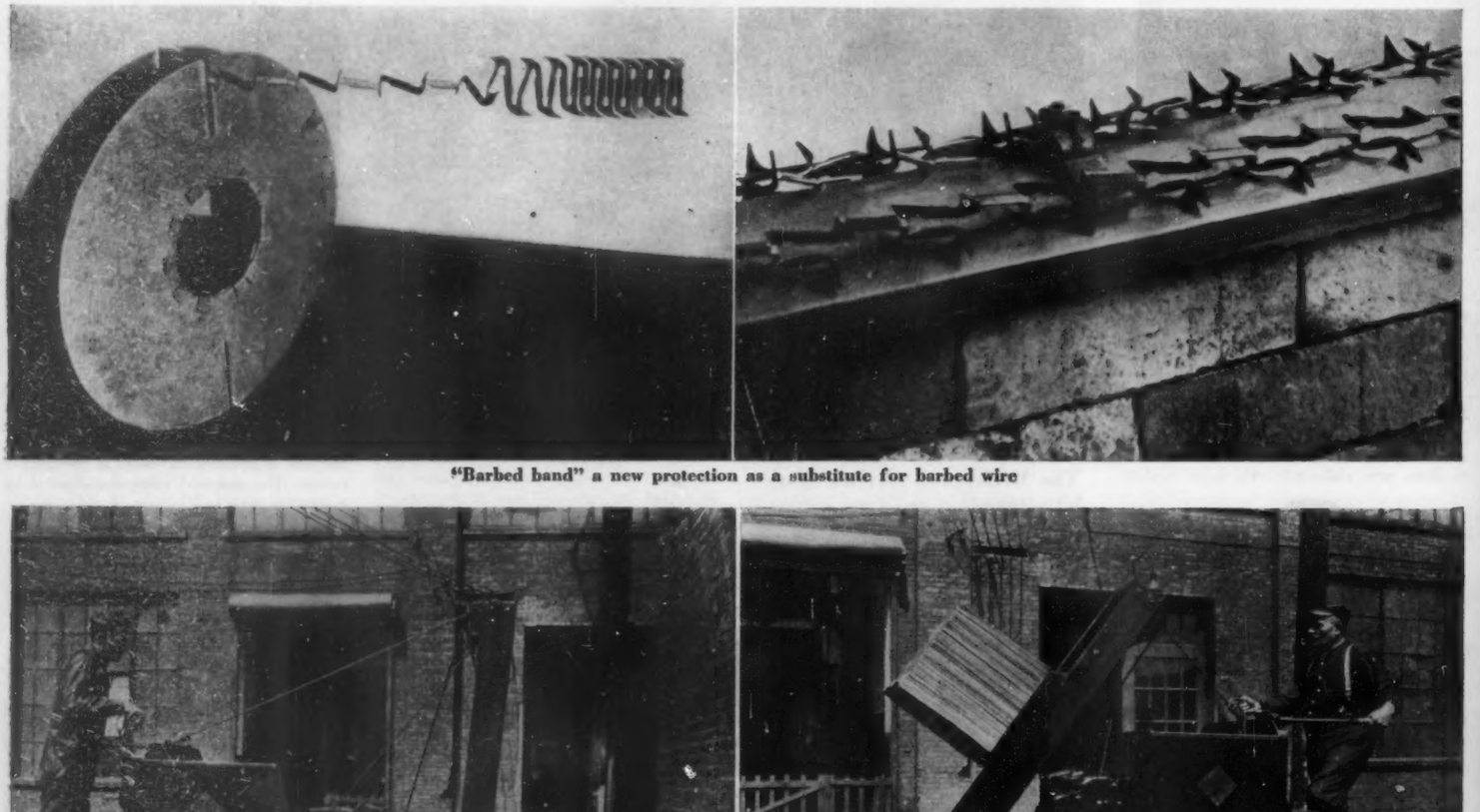
Barbed Band

THE "barbed band" shown in our two photographs consists of strong hoop-iron, punched on both sides, so that a small barbed band can easily be stretched. The punching is done in such a manner that the barbs protrude in small spaces. Inasmuch as the stretching is done at the place where it is used, one need carry only a small ring of the punched band, showing no barbs.

Another position for the work desk

A Tructor for Handling Tin Plates

THE motions of this new battery-operated "tructor" resemble those of a man doing similar work. The steel forks or forearms are thrust beneath the load. The truck picks up 4,000 pounds of greasy tin sheets.



"Barbed band" a new protection as a substitute for barbed wire

Tin-plate handling unit operated by a battery tructor carries the sheets to the machines or deposits them on a pile

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Lost Flower Is Found Again

A SPECIES of flower which was discovered about the year 1750 and then lost for 175 years has been independently rediscovered by two scientists, Dr. E. T. Wherry of the United States Bureau of Chemistry and Dr. J. E. Benedict of the United States Museum. This rare flower is known as the pink turtlehead. It was found near Marlboro, Maryland.

The pink turtlehead grows in wet ground, reaches a height of about three feet and has pink flowers resembling the neck of a turtle. Dr. Wherry states that this rare plant was collected by John Clayton, a noted Anglo-American botanist in the middle of the 18th Century and was sent by him to Linnaeus, in Sweden. Linnaeus named it *Chelone obliqua* and it is so listed in the botanical manuals. Here, however, the species described refers to a plant which may or may not be of the same species, and which comes from a wholly different region from that in which Clayton is known to have collected, namely, Illinois and the neighboring states. As Clayton did all his collecting on the Coastal Plain in eastern Virginia, botanists have for some time been hoping that this plant might be rediscovered in that region.

Possibly some of our readers will be able to locate it elsewhere.

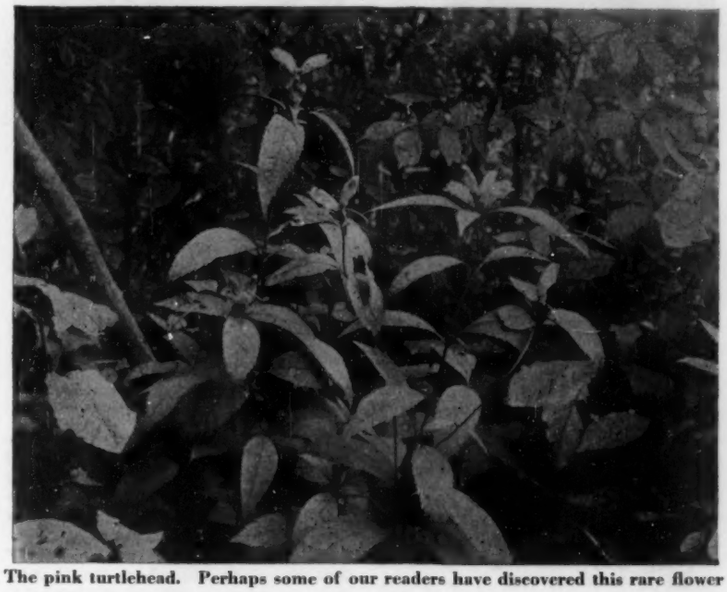
* * *

Portable Mine Piping

To provide fresh air for mine headings, a flexible tubing which has an efficient air delivery range of one-half mile from the fan, has been tested by the Bureau of Mines and is giving satisfaction in both metal and coal mines.

This tubing is made of a heavy fabric thoroughly impregnated with fungus-and-acid-resisting compounds. It is light in weight—one man can readily carry 200 feet, as our illustration shows, and it can be quickly installed—one man in a timbered tunnel can put up over 400 feet in two hours.

A messenger wire is strung on pegs or posts 20 feet apart. Each section has grommet holes in the seam, spaced 18 inches apart, and suspension hooks on the wire engage these holes. The sections, each ten feet in length, have rings on either end. These rings are covered with the fabric. They can be slightly compressed in diameter so that one will fit inside and beyond the other, thus forming an overlapping joint which becomes tight as the air pressure is increased. Where it is desired to clear the heading in a mine when the shots are very heavy, a special section or blasting piece is fitted with snap hooks and when in delivery position this is coupled to the main line. Just before firing the blast, this section is unsnapped and is run back out of danger on a parallel side line. Any damage to the tubing at any time can be as readily repaired as an automobile tire.



The pink turtlehead. Perhaps some of our readers have discovered this rare flower

* * *

The Truth and Some Hokum About Melting Out Ice Jams

INACCURATE, unscientific newspaper accounts of the efforts of Prof. Howard T. Barnes of McGill University, Montreal, to move an immense jam which was threatening early in March to wipe out Franklin and Oil City, Pennsylvania, had the effect of misinforming a large section of the public concerning the nature and use of the well-known substance known as "thermit" which was being used for that purpose. Some of the papers stated that thermit, which generates a temperature of 5,000 degrees, Fahrenheit, was invented by Professor Barnes for the purpose of melting the immense jam of ice in the Allegheny River. Neither statement is correct.

By the time this account, written March 17th, reaches the reader, the two thriving Pennsylvania communities will probably have been delivered from the threat of an unprecedented accumulation of river ice, or else largely devastated by that same ice.

The repeated statement in the press that Professor Barnes, a professor of physics, was actually trying to *melt* the river ice created such extreme doubt in the mind of the writer that Professor Barnes was requested by mail to state the true facts. Not only some newspapers, but certain magazines have persistently created the false impression that it is feasible to get rid of snow or ice by melting it. Any schoolboy who has studied elementary physics, knows, however, that the amount of heat energy required to melt an appreciable quantity of ice or snow is so great that all such attempts, whether they involve the use of hot furnaces, heated snow-rollers or heated electric wires, are foredoomed to utter economic failure. Yet, this perennial notion of the impractical inventor and of the ignorant or unconscionable writer of pseudo-scientific feature stories will not down. This is what Professor Barnes writes:

Oil City, Pa., March 14, 1926.

Your letter of the 11th, relative to thermit in ice, has just reached me here. I have developed as a result of thirty years' experience with ice research on the St. Lawrence River, new and powerful methods for ice fighting. The use of "thermit," which is the old stand-by of the Goldsmith patents, has enabled me to cope successfully with large ice packs in the St. Lawrence, and I have come out here for the purpose of helping these people at their urgent call for help out of a dangerous situation. Thermit is merely a tool in my hands which does very wonderful work in relieving ice accumulations. The theory of its use and effectiveness in ice is very difficult to make clear in a brief letter, but it is based on sound physical principles and is no experiment.

However the possibilities of its greater development are becoming more important and convincing since I first commenced to use it during last winter in taking out the large ice jams at Waddington, New York, and below Ogdensburg, New York, where we moved a million tons of ice in nine hours.

I have been very conservative in developing these methods and, although I successfully used thermit heat treatment last winter and during the present winter at the Cedar Rapids power development, I have carefully avoided publicity.

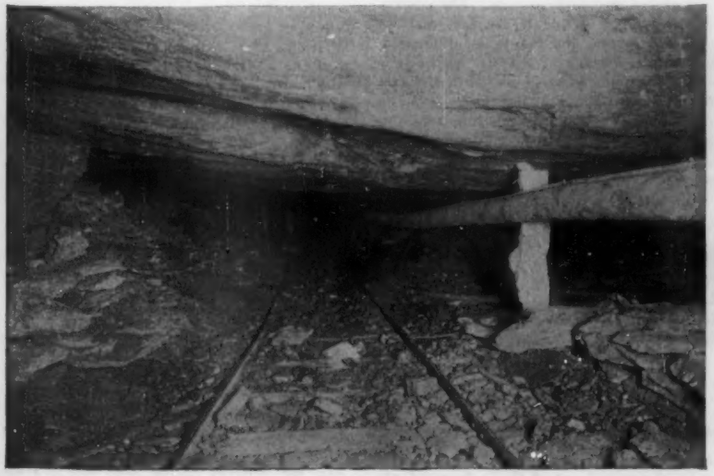
It has been in my mind several times to send you a scientific article with my own photographs of the new method. Yet no idea of the magnitude of the possible effects can be conveyed through a photograph.

Remember that the thermit is only a means of making the ice explode, and in itself is harmless and safe to use and transport. Dynamite and thermit cannot be compared because their action and function are so entirely different. The slow heave of an explosion, set us in the ice by the intense heat of thermit, is ideal for cracking and weakening the ice over a wide area. I have set up a crack over 600 feet long in 27 inches of hard, blue, uniform ice.

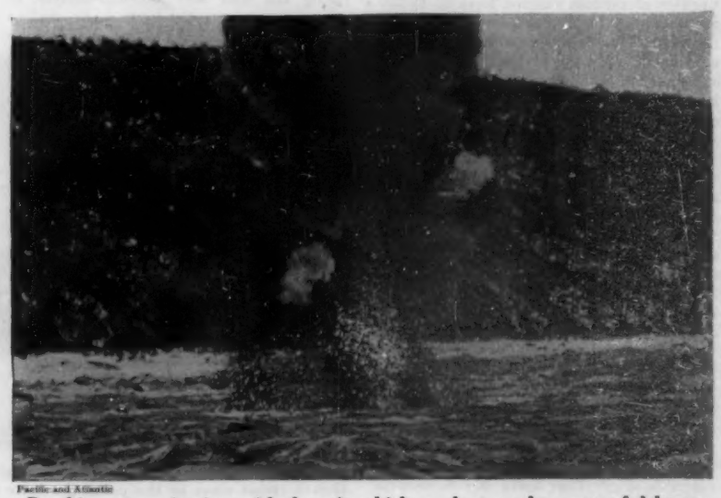
The high temperature of thermit radiates out its energy in a short wavelength that penetrates this ice and water a long distance before becoming entirely absorbed, thereby loosening the binding force between the crystals of ice in the same way that the sun's rays honeycomb the ice.

The whole thing is so new and interesting that much confusion exists in the mind of the public as to what I am trying to do. For example, many engineers and chemists ridicule me because they think I am trying to melt the ice. This is of course absurd. It is, however, a wonderful sight to watch the ice burning, due to the generation and oxidation of monatomic hydrogen.

Please understand my object in coming here. I want to do everything humanly possible to save these people from a greater disaster than they realize. I am using every known method of ice fighting. I have an organization here, military in its general scope, and I am



Flexible, temporary tubing of fabric is used in many mines for supplying air



Pacific and Atlantic

Breaking up an ice jam with thermit, which produces a slow, powerful heave

carrying on a campaign against a powerful and relentless enemy entrenched before the walls of these two cities. I have a dozen committees at work reporting to me every night.

This whole situation is a great physical research and I am applying the laws of physics on a big scale in the open instead of in the laboratory.

Pardon my long letter, but I very much value your sympathy and need your moral support, as I am working out these methods of ice engineering entirely alone.

Yours sincerely,
Howard T. Barnes.

Discovering by accident that Professor Barnes was temporarily in New York, the writer obtained an explanation of his work from him direct. Thermit is composed of aluminum mixed with iron oxide ($F_2 O_3$). It has been used for years whenever it was desired to obtain great heat. For example, it is used for welding broken castings. It is a trade product. Its name is not "thermite," a spelling recently given wide currency by reporters who must have been influenced by an imagined analogy with "dynamite."

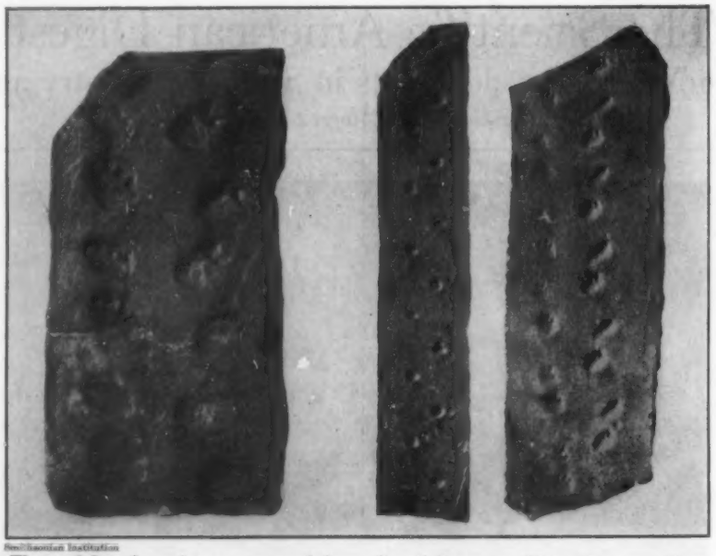
Smithsonian Institution

This slab of sandstone, 8 by 25 feet, is located 950 feet below the rim of Grand Canyon. Stone steps were built beside it

This mixture of aluminum and iron oxide is not explosive. It can be ignited only at 2,800 degrees, Fahrenheit, or higher. At that point, a chemical reaction starts. The aluminum combines with the oxygen in the iron oxide, forming an oxide of aluminum. A temperature of 5,000 degrees, Fahrenheit, is obtained in a few seconds.

What Professor Barnes does is to confine amounts of thermit, ranging from 10 to 250 pounds, in a metal container. He places this in the ice and detonates it with a dynamite squib. A wave of heat rushes out in all directions. The temperature gradient between the 5,000 degrees of the reaction and the 32 degrees, or lower, of the ice is so steep that this wave of short heat waves and visible light rays is radiated out several feet. This heat is absorbed by the boundaries of the ice crystals. It weakens but does not appreciably melt the crystals themselves. It loosens them just as the sun's light does.

A second effect, which was unanticipated, is explosive. The intense heat of the reaction breaks down the hydrogen and oxygen molecules of the ice without melting them. They pass directly into gas. Monatonic hydrogen is formed. This burns, producing flame. This dissociation releases an immense volume of gas which acts like an explosive of a slow type. Thermit thus acts much like black powder, giving a slow heave that breaks up the ice over a considerable area. That heave may be seen in the photograph.



Smithsonian Institution

Three slabs of sandstone removed from Grand Canyon. They show excellent footprints of animals whose actual fossils have not yet been discovered

Fossil Footprints from the Grand Canyon

TRACKS of extinct animals, at least 25,000,000 years old, have been discovered in the Grand Canyon of the Colorado River and are so remarkably well preserved that they have been prepared as a permanent exhibit on the Hermit Trail in the Canyon, to teach a lesson as to the great antiquity of the animal life that once roamed over these ancient sands millions of years before the Colorado River had excavated the deep canyon in which it now flows.

These tracks are fully described in a booklet issued by the Smithsonian Institution (Washington, D. C.), entitled "Fossil Footprints from the Grand Canyon," by Dr. Charles W. Gilmore, Curator of Vertebrate Paleontology at the United States Museum. Since so many hoaxes concerning fossil footprints have been announced from the Rocky Mountain states within the past year or two it is interesting to obtain from the same region the description of a group of fossils which are genuine and which have been scientifically interpreted. The fossils of the Hermit Trail occur in a fine-grained sandstone of Permian age, the period after the Carboniferous or principal coal-forming period.

After visiting the site on which the fossil footprints were discovered, Dr. John C. Merriam, president of the Carnegie Institution of Washington, conceived the idea of having a permanent exhibit of these footprints prepared, but left in their exact original place.

The sandstone which bears the prints stands at an inclination of about 30 degrees, facing the trail over which hundreds of tourists pass on mule back. The surface layers were first stripped off, whereupon more footprints came to light, fresh and clean as the day they were formed by the feet of crawling animals in the Permian Period, except, of course, that the sand long ago became sandstone. A smooth surface eight feet wide by 25 feet long, bearing many tracks leading up the slope, was thus uncovered. A flight of stone steps was laid close beside this slab, permitting the tourist to approach and closely inspect the footprints. In addition there are several other slabs of a similar nature close by.

"The great antiquity of these footprints," says the Smithsonian Institution booklet, "which occur from 900 to 1,080 feet below the level of the present rim of the canyon, is clearly demonstrated at this locality. It is obvious that since the day when those animals impressed their feet in what at that time was moist sand, more than 1,000 feet of rock-making materials were piled up in successive strata above them, and this does not take into account many hundreds of feet more that have been eroded off from the present top of the canyon wall. The great length of time required for the cutting away or erosion of the rock to form the deep canyon, and the even longer time necessary for the original deposition of this great vertical mass of stone is, when translated into terms of years, if that were possible, so stupendous as to be almost beyond human comprehension."

Some of the slabs were literally covered with imprints, says the report, and curiously enough all pointed in the same direction, up the steep slope of the sandstone layer, suggesting an old trail leading to the water, or possibly recording a great migration of animal life. Out of all the tracks but one exception to the uphill movement was noted.

The report then describes individually the various footprints, most of which cannot be identified, while some quite closely resemble those of animals which paleontologists have found in fossil form. One or two have even been placed in a definite class. The poverty of these results is due to the fact that we have nothing but the footprints of the animals to judge from. Where we have fossils of animals found in other places, whose feet might be identified with the tracks found in the locality under discussion, the identification is less difficult. In many cases we lack even the fossils of animals which could have made the tracks, and until these are found here or elsewhere we must fall back on very slender evidence from which to deduce the nature of the animal which made the track.

In the illustration showing three slabs of sandstone, the one on the left bears footprints of a new species. The creature that made these tracks was apparently a short, squat quadruped with a wide body and was evidently slow of movement, as indicated by the short stride. Two amphibians of the Permian Period (the period that followed the Carboniferous or chief coal-forming period), *Cacops* and *Trematops*, may be responsible for the tracks. Actual fossils of both these genera (see illustration of *Trematops*) have been found elsewhere.

The center slab shows the tracks of some narrow-bodied creature with long legs. The hindfoot impressions have partly obliterated those of the forefeet; they show that the greater part of the animal's weight was on the hindfeet. A few of the impressions indicate five short, round toes. The slab on the right has been identified as *Laoporus nobeli*, the tracks being beautifully preserved.

Dr. Gilmore of the Smithsonian Institution has planned to return to the site of these discoveries about April first and to spend a month or more searching for new discoveries that will shed new light on the habits of the animals that made these trails.

Smithsonian Institution

Cacops, an extinct, primitive amphibian twenty inches long. On the tree of evolution it stood close to the parting of the ways of the reptiles and their descendants the mammals, from the amphibians. *Trematops* was a similar form

* * *

An Ingenious Telescope Mounting

IN the "Editor's Mail" department of the April issue of the Scientific American, Mr. Virl Davenport of Quantico, Virginia, narrated his persistent and successful efforts to grind and polish a concave mirror for a reflecting telescope, without the proper abrasives, these being unobtainable. Owing to the fact that he had to finish his grinding with automobile valve-grinding compound having coarse grains of carborundum instead of the fine grains used by telescope makers, it required 200 hours, instead of the usual nine, to do the polishing with rouge. Mr. Davenport has now completed the mounting of his telescope and at our suggestion he has sent us a photograph and description.

Photo by Virl Davenport

A short-focus, reflecting telescope made almost entirely from parts salvaged from various sources, including a scrap pile

This work was begun a year before the appearance of Mr. Porter's recent articles in the Scientific American (reprinted in the book, "Amateur Telescope Making," Scientific American Pub. Co.), but he was able to make use of Mr. Porter's instructions in the final figuring of his mirror.

"The mounting, including the tube and all the fittings," writes Mr. Davenport, "excepting the brass in the adjusting and clamping screws, was obtained from the scrap pile. The base is an aluminum casting, the patterns having been whittled out with a jack-knife and trimmed with a hack-

saw blade. The soft pine for the pattern was the largest single item of expense in the whole telescope. With a little knowledge of foundry practice and a few pounds of aluminum from an automobile grave-yard and a good, hot coal fire, any amount of small aluminum castings may be made in the kitchen.

The polar axis turns on ball bearings. The axle is a tapered, steel tube, as is the declination axis. The cradle for the tube is made of sheet steel, bent to shape and brazed. The bands encircling the tube are from an old banjo. The mirror cell and counter cell and dustcap are "Aunt Het's Favorite Cake Pans." The tube is a length of extra-large stove pipe. The eyepiece draw tube is the bushing from an old bearing. The finder supports are fittings from an old motor boat. The polar axis movement is the connecting rod from a gasoline motor. The mirror has a diameter of eight inches and a focal length of twenty-four. Index circles and a driving clock are next in order, and, of course, a pier on which the telescope may rest."

When the Scientific American stated, several months ago, that a reflecting telescope could be made for less than $50, many people expressed doubt. Mr. Davenport has not given us a bill of costs, yet the ingenious manner in which he has extemporized the working parts of his mounting confirms our belief that the average amateur, if he will make use of discarded equipment of various kinds, can bring the cost of his telescope considerably within that sum. It would doubtless be appreciated by other telescope makers if those who plan to submit photographs of their completed telescopes to the Scientific American for publication, were to keep itemized accounts of all the costs, as well as of the time required for the various phases of the work, and allow us to publish a few of them.

The Japanese whose minute freehand writing has attracted much attention

At the present writing, early in March, we have heard from nearly a thousand would-be telescope makers, and it is likely that by the time the present issue has reached our readers, the majority of those who have purchased the book "Telescope Making" will have already begun work on their mirrors. It is therefore pleasant to think, each evening as we begin work in our own little cellar telescope laboratory, that hundreds of others are grinding and polishing their mirrors, and that by midsummer a large proportion of these will be looking at the heavens through them.

* * *

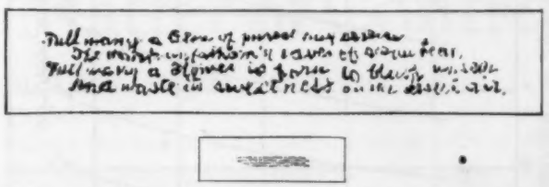
Miniature Writing in Japan

THE hand is quicker than the eye!" the expert with the pea and with three walnut shells used to cry at the fair grounds. He proved it to us.

Now comes Mr. Miyake, of Kyoto, Japan, whose slogan is "The hand is more delicate than the eye." By way of proof we reproduce, in the exact size he executed it, four lines from Gray's "Elegy in a Country Churchyard." Only with the greatest difficulty can it be read with the naked eye.

The miniature writing shown below was done with a brush instead of a pen. It is said to be a subconscious form of activity

The extraordinary thing about Mr. Miyake's writing is not that it is so small, but it is the way he does it. Microscopic writing done with the help of magnifiers is not unusual—any normal man with sufficient perseverance can learn to do it—but to write with eyes entirely unassisted, in letters so small that few people can read them, at the same time making each line, angle and curve so clear cut and distinct as to be read easily under a glass, is something of a feat. And this is accomplished with a brush!



Below: **Lines from Gray's "Elegy," just as they were written by Mr. Miyake.** ***Above:*** **An enlargement of this miniature writing**

One of the examples of Mr. Miyake's work which impressed the Empress of Japan when he presented it to her was one hundred poems with one hundred figures of men and women in court dress, all done in a space one and three-eighth inches square. This task he repeated for a group of Scientific American readers who meet monthly in Kyoto to discuss supernormal phenomena.

The question naturally arises: how can his hand execute letters which his eye cannot distinguish? The answer is that the work is a sort of sub-conscious activity. Placed in front of him you see the open volume containing the "Elegy." After wetting his brush and stroking it to a point Mr. Miyake places the tip at the spot where he wishes to begin writing and fixes his gaze on the quatrain which he is to copy. His concentration is intense, exclusive, perfect. Without conscious direction his hand quivers, ever so slightly, in accord with his optic nerve as his eye travels slowly, stroke by stroke, over the printed page. He sees not what he is writing, but the picture before him. To write the four lines reproduced in the smallest cut on this page took him twenty minutes.

Blocks of Straw Yet Houses of Reinforced Concrete

WHILE seeking to eliminate the enormous waste involved in the erection of permanent wall structures composed of heavy masonry units, of which the weight and strength are utilized to a relatively small extent, James Monroe Hewlett, has evolved an ingenious method of building. Indeed, this inventor has combined the well-known insulating qualities of a straw-like fiber with the strength and durability of reinforced concrete; and he has dispensed with the cumbersome and costly molds that are usually used.

Walls of fiber blocks are not only used for constructing new houses but for remodelling old ones. Here is an old frame dwelling which is receiving a facing of this art, which will later be stuccoed

In the new method of building walls, use is made of fibre blocks, which are laid in much the same manner as cement blocks. However, these fibre blocks are provided with round holes, two to each block, and these must be aligned in building the wall. The blocks may be laid in parallel and header courses, while half blocks permit of considerable variation of the arrangement. At every three courses, wire or corrugated strip reinforcing members are inserted in the aligned holes of the blocks, and a 1-2-4 concrete mix is poured into the holes, after which the next three courses are laid—and so on, until the desired height of wall is attained.

Thus, we have a series of reinforced concrete rods which take care of the compression and buckling strains, while the fibrous mass offers an excellent insulation against cold and heat and is an excellent non-conductor of sound. The fibrous surfaces inside and outside offer excellent supports for plaster and stucco, eliminating the necessity of providing expensive furring strips and lath. The fibrous material is fire-proof as well as vermin-proof.

* * *

America Is Developing a Distinct Type of Man

AN American type of man is developing. In the older American stock this type has already reached a point where it is possible, without much difficulty, to distinguish it from the peoples of other countries. This is the conclusion of Dr. Ales Hrdlicka, anthropologist of the Smithsonian Institution of Washington, D. C., based upon many years of scientific measurements and study of those whom he designates as "Old Americans," and of the immigrants differing from the original stock.

"The work, as now completed," says Dr. Hrdlicka, "shows that the older stock has approached the formation of a distinct American type. This type is still nearest to that of its main progenitors, the British, but in stature, in physiognomy, and in behavior, it is already more or less different, American. The type is a good one."

Fiber blocks are laid like bricks. Reinforcing members are put in the alined holes, which are then concreted

He then asks this question: "Have we or have we not scientific grounds for fearing racial deterioration as a result of our former liberal immigration policy?" After a thorough comparison of the data he has collected on the Old Americans and the immigrants, he feels justified in answering this question in the negative.

"These studies give no evidence," he declares, "that the mass of immigrants are bringing inferiority of the body, nor, judging from the size of the head, inherent inferiority of brain. Probably all that is necessary, judging from the success of the children of older immigrants and even of many of the immigrants themselves, is opportunity for wholesome development in favorable American environment. Plainly the immigrants on the whole have not brought physical deterioration."

Dr. Hrdlicka is Curator in charge of the Division of Physical Anthropology of the National Museum, which is under the

tion of the Smithsonian Institution. His conclusions are based upon his most recently collected data and studies, and have been prepared at the request of the American Statistical Association. They are now being published by the Pollak Foundation for Economic Research.

Here is Dr. Hrdlicka's description of the American type of man, so far as it has been developed:

"It is characterized by tall stature, being the tallest of all the larger groups of white people; by, on the average, a medium pigmentation of the hair, with scarcity of adult blonds and near-absence of blacks; by prevalently mixed eyes, or light ones showing more or less of a brown admixture; by an inclination, especially in youth, to sinewy slenderness; and by other features. The main characteristics of its behavior are, in general, frankness, openness yet shrewdness, energy and persistence, with, in general, but little sentimentality or affectation, and relatively few extremes except perhaps in industrial, financial, and occasionally in religious endeavors.

"This type, contrary to recent unscientific belief, is not Nordic; it is not even nearer the Nordic than it is to the Alpine. Like the British, it is an intermediate type. The head and skull are on the average mesocephalic; but there is a wide range of variation, with a considerable percentage of brachycephaly. The face varies from strong in those working muscularly to decidedly subdued jaws and cheekbones in those in prevalently mental occupations. Otherwise it is a type close to the medium of English and white people in general." [Note: The words "mesocephalic" and "brachycephalic" refer to the cephalic index by which skull shapes are commonly expressed. It is the ratio of the greatest breadth of a skull to its greatest length, multiplied by 100. Thus, a skull having a cephalic index above 80 is brachycephalic or short; if from 75 to 80 it is mesocephalic or medium. If below 75 it is called dolichocephalic, or long.—Editor, Scientific American]

The methods which he employed to collect data and arrive at his findings are described by Dr. Hrdlicka as follows:

"Up to recent years the belief in an American physical and behavioristic type has rested on a merely empirical and more or less superficial basis. Such a type has been represented in art and in literature, but its scientific determination has been wanting. It is a well-established fact, however, that people of any nationality, even though of heterogenous origin, after centuries of existence as a linguistic and political group, tend to develop similar habits, similar bearing, similar behavior and gradually even similar physical characteristics, especially similar physiognomy, and thus come to constitute a fairly readily recognizable *type*. How far this development has had time to progress in the United States was until recently a moot question. The general notion was that a type had developed far enough to be without much difficulty distinguishable from the peoples of other countries.

"A critical inquiry into the subject disclosed little of data outside the census statistics, and army and navy measurements (limited to stature and weight), with some records on American children. Under these conditions it was natural that at first the greatest use should be made of the census data.

"The census records showed that the older American stock, or that dating from before 1820, consisted principally of English and Welsh people or their descendants, with strong infusions of Scotch and Scotch-Irish, Germans, Dutch, Irish, and French, in the order named. However, English, and Welsh with their descendants constituted more than three-fourths, and English, Welsh, Scotch, and Irish not far from nine-tenths of the early United States population. These figures are, of course, only approximate and differ somewhat according to various sources. But the main fact is well established; the population up to 1820 was essentially of British derivation; and the American type of that time, it is safe to conclude, must have closely resembled that of Great Britain.

"A century has elapsed since then. The unmixed descendants of the families of 1820 are now at least of the third generation Americans. The old components of the stock, except those—and there are many—who have intermarried with more recent comers, have become considerably unified through admixture among themselves. Moreover, they have now been exposed to from one to three centuries of the American environment, which in many important respects differs from that of the old countries. This must have had some effect upon the behavior-habits and probably even upon the physical type of the old stock, leading it away from British standards toward something more and more American. This would seem to justify the assumption that this country may already have approached a separate behavioristic and physical type as far as the older native stock was concerned, and that it remained for anthropology to determine how far this had proceeded and just what the type was.

"Anthropologists had recognized this problem long before the late war and many years in advance of the mischievous, pseudo-scientific literature which during the last decade has flooded this country and spread alarmistic untruths, bias, and intolerance. This led me to undertake a detailed physical and partial physiological study of the living representatives of the Old Americans."

As to the effects of immigration, Dr. Hrdlicka says:

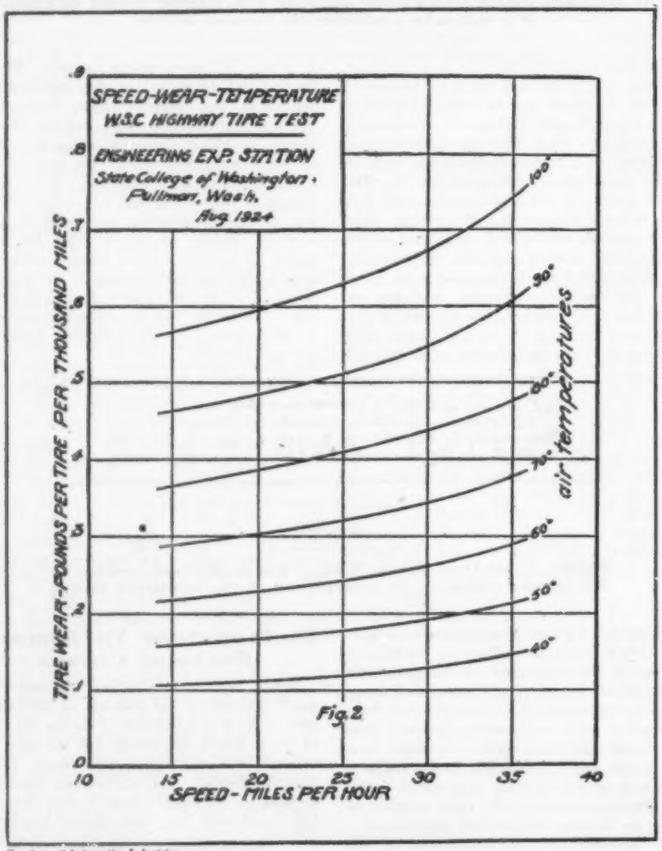
"These data show that during the last one hundred years this country has received, proportionately to its earlier ethnic components, many more Germans, Irish, Scandinavians, Italians, Slavs, and Jews, and a considerably smaller percentage of Scotch, Welsh, English, Dutch, and French. The addition of the new to the older blood, which meanwhile has probably more than quintupled through natural increase, will probably result in a population somewhat more German and Irish, with also a tinge more of Scandinavian and a stronger tinge of Italian, Slav, and Jewish blood than formerly. The great bulk of the population remains, however, in origin of descent, British, or at least Western European. This does not mean much anthropologically. The peoples here named are not distinct races. They are at most more or less recent types. No such type deserves to be called a 'race' unless this term is used loosely, though presumably the type would develop into a race or strain of distinct, fixed character if it had a chance to persist over thousands of years in isolation.

"The various types of white men now existing differ from each other mainly in accordance with their composition from previous types. Thus the German type is a composite of Northwestern Europeans, Slavs and Alpines, in perhaps not greatly differing proportions. The French type results from the admixture of Alpines, Mediterraneans, Southwestern Germanic tribes, and some Normans.

"The present English type is derived from the Neolithic type of man in Britain, the broad-headed Central or Western European type that reached the islands during the Bronze period, the Mediterraneans brought in during the Roman domination, the Germanic tribes of what is now Western Germany and Holland, and the Norman, French, and smaller admixtures. The Slavs are Old Europeans, modified according to locality by the Finno-Ugrians, Scandinavians, Germans, Alpines, Italians, or Turks. The Hungarians are a mixture of Slavs, Dacians, Saxons, Roumanians, Magyars, Szekels, and others. The Italians are descendants of the Latini, Greeks, Etruscans, Gauls, Goths, Slavs, Langobards, Albanians, Phoenicians, and Sards. The Jews carry the blood of every people with whom they have lived. And so with others. Upon analysis every larger European group, even the Nordic or Scandinavian, is found to be a composite of older groups which generally represent all the three main strains of white men, namely, the Nordic, Alpine, and Mediterranean. Most, if not all, have also more or less of a trace of the yellow-browns or blacks."

Dr. Hrdlicka's study shows that:

"The bulk of the immigrants represented in our records, outside of head form and a few other features, are remarkably uniform in physique, with the exception of the Jews and the Southern Italians, both of whom are characterized by smaller stature and other more or less aberrant features. They are, in general, a good, sturdy lot. In average stature, in size of chest and in muscular strength, they are above the mean of the Europeans. They present, as groups, no signs of physical degeneration."



Courtesy of Automotive Industries

How temperature and speed affect tire wear. Speed increases it slightly, while temperature increases it greatly

* * *

What Kind of Paving Wears Motor Tires the Least?

SOME remarkably interesting tests have been made in order to determine the relative degree of automobile tire wear on concrete roads, as well as on good macadam roads and very poor, rough macadam roads; also in order to determine how much the temperature of the air effects tire wear. The results of three groups of experiments have been abstracted by *Automotive Industries* (New York) from bulletins of the Bureau of Public Roads of the U. S. Department of Agriculture (Washington, D. C.), from those of the Engineering Experiment Station of the State College of Washington (Pullman, Wash.), and the Engineering Experiment Station of the Iowa State College (Ames, Iowa).

It was found that there is an immense difference in tire wear between concrete roads and various macadam roads. Also that as temperature goes up, tire wear increases to a surprising degree.

In the case of the Washington College tests, the chief object was to determine whether the saving in fuel and tire wear due to good roads, warrants the increased cost of such roads. Tire wear was determined by removing the tires, with the rims, from the cars, cleaning them thoroughly, deflating them and weighing them on a sensitive balance. This was done both before and after a test run. The average of the weight of rubber worn from four tires was taken. Runs of fifty to seventy-five miles proved sufficient for decisive results, except on concrete roads.

This, by the way, speaks loudly for that kind of roads. New tires should not be used in these tests, as the sharp edges wear off unduly at first; while old tires are apt to lose large particles or flakes of rubber.

It was found that rubber cuts more rapidly when wet than when dry. It was also found that the temperature of the air has a great deal to do with tire wear, as the graph which we reprint shows. One might expect a few percent increase in wear, due, for example, to the rise in temperature from that of a frosty morning to a hot noonday; but the rise of about 700 percent indicated on this graph is a distinct surprise.

Speed, on the other hand, does not bring about as great a difference in tire wear as temperature does. Take, for example, a spring day at sixty degrees, Fahrenheit. At fifteen miles per hour the wear is about .22 pounds per tire per 1,000 miles. Increase your speed to double—thirty miles per hour—and the wear only increases to about .27 pounds per tire for every 1,000 miles.

Those of the tests which were made by the Engineering Experiment Station of the Iowa State College show that with a Ford touring car the fuel consumption on poor macadam roads ranges from 100 percent to 147 percent of the consumption on concrete road; but tire wear showed a much greater difference than this, the treads wearing off about seventeen times as fast on good macadam, and *fifty-six times* as fast on very poor macadam as they did on concrete.

It is pointed out, however, that the latter figures are likely to be misinterpreted, and disappointment is in store for him who expects to get fifty-six times the mileage on a concrete road that he gets on a poor macadam road! That is due to the fact, which will be obvious to everyone, that other factors as well as this one, limit the life of the tire.

(*Continued on page 334*)

Which Fire Are You Choosing?

Fires Are a Matter of Control

Consider this example. A lighted cigar falls into a waste paper basket. If the basket is combustible the fire spreads to a rug, then to a desk, also of combustible construction. Later the fire follows the rug to a file and a stenographer's desk. The entire contents of the office are consumed but there the fire stops. Sheet Steel partitions, doors, and trim bar further progress. The example is real—it happened in the Guardian Building at Cleveland.

But the example is far from ideal. Think what would have happened if the waste basket and the office desks and files had all been of Sheet Steel construction. The fire would have burned itself out in the waste basket. A scorched rug is the most that could have happened.

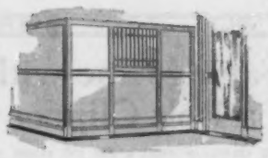
Now here is the point—that fire was chosen when the owner chose office equipment. Had he chosen steel when he made his purchase he would have had a waste basket fire.

It was choice that stopped the fire too—the choice of the Sheet Steel partitions, doors and trim. Without them a floor or the complete building might have been heavily damaged. The historic case of the Burlington Building at Chicago proves this possible.

It will pay every business man to give the closest attention to the question of fire control when choosing materials for factory or office equipment as well as for building construction. No one questions the desirability of fire-resisting construction; fire-safe contents are just as important.

Several articles dealing with this vital item of fire have appeared in the booklet, "MAKING MARKETS," which is issued regularly by the Committee. Copies will be gladly mailed those interested on request.

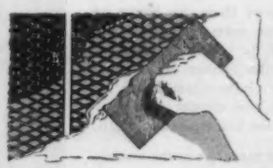
SHEET STEEL
TRADE EXTENSION COMMITTEE
OLIVER BUILDING
PITTSBURGH PENNSYLVANIA



Sheet Steel partitions both increase the fire-safety of buildings and provide for re-arrangement to meet changing conditions. Compact, economical, easily cleaned.

Shelving of Sheet Steel provides the place for everything that is essential to keeping "everything in its place." In many instances steel has reduced space requirements as much as fifty per cent.

Sheet Steel furniture is easily cleaned, durable and economical. It greatly increases fire-safety by reducing the amount of combustibles and by retarding the rate of combustion.



Expanded metal lath—made from Sheet Steel—gives permanence to the beauty of plaster walls and also adds greatly to the fire-safety of the building.

MASTER TEC BRAND

Look for this Master Brand. It assures you—that the sheets furnished for your service are of standard prime quality—that they are of the gauge stamped on the sheet—if galvanized, that the coatings for the various gauges and uses are the weight and quality established by standard specifications.

Sheet Steel which bears the Master Brand, can be depended upon to give economical and lasting service.

These Are

Bolt Clipper Times

VOL. I EVERETT MASS., U.S.A. NO. 1

Saving time with a Bolt Clipper

You certainly start a life job when you undertake to discover all of the innumerable ways in which a bolt clipper can be used around the shop, the factory and the home. Every time you discover a new use you find a new way to preserve the purity of the English language and to increase the value of your working day—because a bolt clipper does its work without the aid of strong language and does it quickly. Bolts, nails, wire, rods and chains are essential contributions to housing, transportation, power and construction; from the hen coop to the concrete road; from the wheelbarrow to the motor bus.

Cutting Heavy Fence Wire

Perhaps you don't know what a bolt clipper is?

It's a tool for cutting off rods, bolts, heavy wire and chains to desired length, anywhere.

When we say bolts we mean big husky ones up to ¾" in size—the kind you find around the automobile mud guards, holding the door plates to the furnace or the sides on the kitchen stove. When we say rods we mean anything from the brass rods which hold up the parlor curtains to those husky iron reinforcements you see in concrete walls.

By wire we mean the clothes line, the radio aerial, guy wires on poles and fences as well as insulated wire on power lines, cables, etc.

As to chains—well of course there are limits to what even a bolt clipper will do but when it comes to the broken links on a tire chain—just reach for the bolt clipper and snip off the broken cross chain.

Our message to the readers of *Scientific American* must be general because this magazine reaches all sorts of tool users—men in all walks of life. When we talk to the automobile mechanic, the road builder, the railroad man and others we can deal with specific uses in each one's work—but in this issue of the Bolt Clipper Times we can suggest only a few of the thousands of general uses to which the hundreds of thousands of readers may apply this tool. A bolt clipper belongs in every tool kit, on every work bench, in factory, home and farm shop and is an essential item of equipment for railroad construction men, repair crews on power and telephone lines, on ships, fire department apparatus, in mines, lumber camps—and wherever time saving is essential and man power limited.

Cutting Fender Bolt in Hard to Get At Place

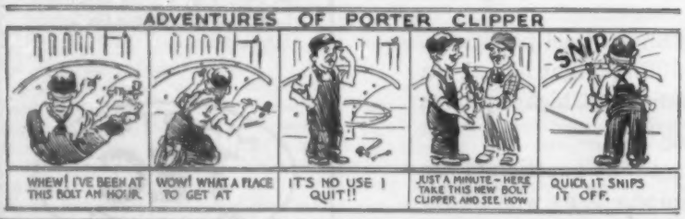
Housewife Cutting Brass Curtain Rod

To those of you who are unfamiliar with these tools just imagine a device so powerful that it will cut a quarter inch rod as easily as the ordinary nipper cuts the small wire on a radio set. Imagine a two handed tool multiplying man power seventy times. Imagine splitting the nut of a bolt in one operation with moderate effort or snipping off a wagon bolt almost as easily as a pair of scissors cuts a piece of twine.

Splitting Nut on Brake Drum

Every hour of every day some man somewhere is laboriously wasting time making work out of a job that should be done with a bolt clipper. If you use tools or if you employ men who use tools we suggest that you write to us or to your tool supply dealer for booklet describing the Porter line of cutting tools. Write to dealer or to H. K. Porter, Inc., Everett, Mass., U. S. A.

ADVENTURES OF PORTER CLIPPER


SNIP
WHEW! I'VE BEEN AT THIS BOLT AN HOUR.
WOW! WHAT A PLACE TO GET AT
IT'S NO USE I QUIT!!
JUST A MINUTE—HERE TAKE THIS NEW BOLT CLIPPER, AND SEE HOW
QUICK IT SNIPS IT OFF.

Barnes Electric Bench Scroll Saw

Not a toy, but a practical, useful tool for shop or home. Runs from lamp socket.

Price includes boring attachment, emery wheel, etc.

Write today to

W. F. and John Barnes Co.

ROCKFORD, ILLINOIS

CORROSION

There are as many causes as there are phases, types and effects of it. UNISOL corrects corrosive conditions as soon as it is introduced into boilers.

UNISOL MFG. CO., Jersey City, N. J., U. S. A.

SIME, DARBY & Co., Ltd., Singapore, S. S.
Agents for Straits Settlements

How the clean oil is separated from the solid matter and washing solution

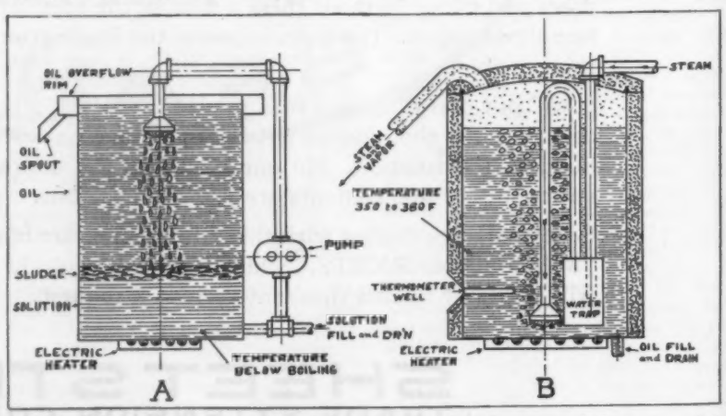
A Simple Method of Reclaiming Old Crankcase Oil

THE tremendous waste of food material that is going on all the time, due to throwing away the drainings from automobile crankcases has impressed itself upon most automobile owners. In city garages, these drainings are sometimes worse than useless at the present time, for city ordinances prohibit throwing them into the sewers, and they become a burden on the hands of the garage proprietors.

With a very general interest in the subject in the last few years, and the development and use of numerous oil purifying devices, the amount of this waste is being rapidly reduced. It was the good fortune of Mr. C. D. Miller, Associate Agricultural Engineer of the Alabama Polytechnic Institute, to have worked out a process for reclaiming the drainings, that is simple, inexpensive and effective, and that can be used to handle them in small or large amounts as may be required. The process seems to be capable of such general application that every drop of oil that is drained from a crankcase anywhere, can be profitably saved and returned to a condition of usefulness equal to that of the new oil. Whether this estimate of the process is correct, remains for the reader to judge and for developments to determine.

As a preliminary to the description of the new process, it may be of interest to cite briefly an older process, of which the new one is a development. As this older process seems to have originated with the De La Vergne Machine Company, makers of Diesel engines, in New York City, it may be designated as the De La Vergne process. It has been used with good results in some cases, and in others, it has been a complete failure. With oil from the army flying machines, it has been used successfully, apparently on account of the quality specified for both the lubricating oil and for the motor fuel or gasoline. It has not been found to work out satisfactorily with the general run of automobile crankcase drainings, on account of two difficulties. One is that some of the oils being used will emulsify when an attempt is made to treat them in this way, the resulting mixture of oil, treating solution and sludge being a hopeless mess, impossible to separate, in a practical way. The other is that the temperature of saturated steam at atmospheric pressure is not sufficient to volatilize the heavy kerosene-like constituents of commercial gasoline that are absorbed by the oil. The result is, that even if the oil does not emulsify so that it can be treated with some measure of success, the product is thin and lacking in body, whereas in order to be entirely successful, a reclamation process should restore the oil to its original body as a new oil, by the complete removal

(*Continued on page 336*)



***A* is the cleaning tank, in which the oil is treated and separated from its solid impurities. *B* is the steaming tank, in which the absorbed gasoline is carried out of the hot oil by means of steam**

A Challenge
We'll make a little wager with you that if you try one tube of Listerine Tooth Paste, you'll come back for more. LARGE TUBE—25 CENTS

DANDRUFF?

Bottle Bacilli, the cause of Dandruff. Illustration Reproduced from Hazen's "Diseases of the Skin." C. V. Mosby, Publisher.

Dandruff, known scientifically as Pityriasis Simplex Capitis, is a disease of the deeper rooted cells of the scalp.

It may spread by infection through personal contact (combs, brushes, etc.). Many people, for instance, and especially children, are free from the disease until infected by actual contact with dandruff bacteria.

Dandruff is a disease difficult to cure, but easy to check.

When checked it has a persistent tendency to reappear, and often in more virulent form, with possible loss of hair or even total baldness.

The treatment to check dandruff requires constant cleanliness and the use of a suitable antiseptic solution to combat the disease and to heal the scalp.

Do something about it!

DANDRUFF is a danger signal. If you have it you should do something about it.

Perhaps you never knew it before, but dandruff is a germ disease. It spreads by infection from personal contact, as with the common use of combs and brushes. Children, for instance, are never troubled with dandruff until actually infected by some contact.

Dandruff is a disease difficult to cure but easy to check. It has a tendency to reappear, unless properly treated, and often brings with it the possible loss of hair or actual baldness.

The ideal treatment to combat dandruff conditions is the systematic use of Listerine, the safe antiseptic.

We have received hundreds of unsolicited letters from Listerine users, who are most enthusiastic in their claims for what Listerine will do in this way. If you are troubled with dandruff you owe it to yourself to try it.

The use of Listerine for dandruff is not complicated. You simply douse it on your scalp, full strength, and massage thoroughly. The effect is antiseptic, cleansing and healing. And you will be amazed to see how this treatment, followed systematically, combats dandruff.

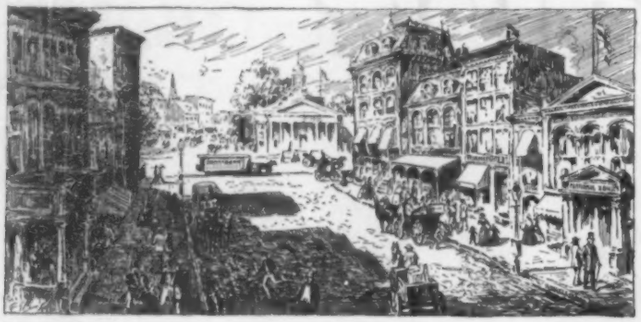
Moreover, Listerine will not discolor the hair nor will it stain fabrics.

Not only men but women have become devoted users of Listerine for this purpose—women, particularly, since bobbed hair has been in vogue and has made them more conscious of dandruff if it happened to be present.

Try Listerine some evening when your scalp feels tired and itchy. Dandruff is probably causing the trouble. Apply it generously and then massage vigorously. You will find it a stimulating tonic for the scalp, and in addition to combating dandruff, you will find that it adds that luster and softness to the hair that is so important a part of being well-groomed.—*Lambert Pharmacal Co., St. Louis, U. S. A.*

LISTERINE

—and dandruff simply do not get along together



The Telephone and Better Living

PICTURES of pre-telephonic times seem quaint today. In the streets were horses and mud-splashed buggies, but no automobiles and no smooth pavements.

Fifty years ago homes were heated by stoves and lighted by gas or kerosene lamps. There was no domestic steam heating or electric lighting, nor were there electric motors in the home. Not only were there no telephones, but there were no phonographs, no radio and no motion pictures.

The telephone permitted the separation of business office from factory and made possible the effective co-ordination of widespread activities by a centralized organization. It changed the business habits of the Nation.

The amazing growth of the country in the past fifty years could not have come had not science and invention supplied the farmer, manufacturer, business man and family with many new inventions, great and small, for saving time and labor. During this period of marvelous industrial progress, the telephone had its part. It has established its own usefulness and greatly accelerated the development of the industrial arts which have contributed so much to better living conditions and to the advancement of civilization.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

"WONDER" Cold Pipe and Tubing Benders
Do Not Crack, Flatten or Crimp the Pipe

Standard of the World
Hand and Motor Operated
14 Sizes of Machines
What it costs to bend pipe one way, per bend:

¼-inch pipe	5 cts
⅜-inch pipe	10 cts
½-inch pipe	20 cts
¾-inch pipe	40 cts
1-inch pipe	60 cts
2-inch pipe	$1.00

American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.
Send for Catalogue

ROTARY PLANET CHART

With the new rotary PLANET CHART, good until 1950, you can, by mechanical means, quickly and easily locate any planet at any hour. Price $1.00. Description furnished on request.

E. J. BUNKER Bentleyville, Penna.

PATENT FOR SALE

SAFETY DEVICE—For hazardous machinery like power saws and punch presses. Gives warning by high frequency high potential electric spark when operator's hand approaches danger zone. Address R. L. Morrow, 58 Lincoln St., Meriden, Conn.

UNIQUE THIN LEAD COLORED PENCILS

Blue	1206
Red	1207
Green	1208
Yellow	1209
White	1215

Also 7 additional colors for Figuring, Checking Underscoring and Marking Blueprints

$1.00 per doz.

At all dealers or write direct
American Pencil Co., 217 Fifth Ave., N. Y.
Makers of the famous VENUS Pencils

Ideal for Artists, Draftsmen, Accountants, Executives, Instructors, Etc.

The New South Bend LATHE

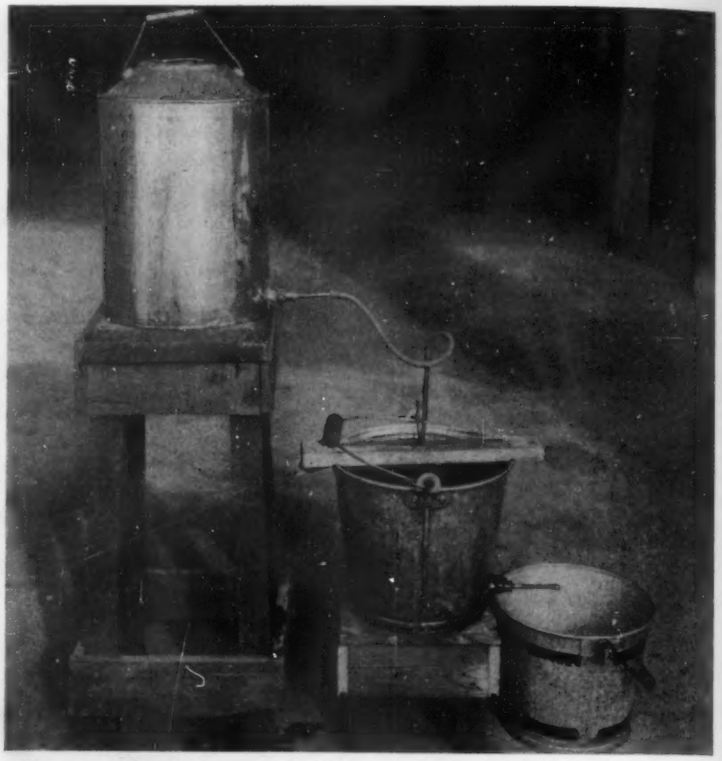
New Lathe Catalog Free!

Shows 96 styles and sizes from smallest Bench Lathes to Largest Factory Production Size.

The New South Bend Lathe

is heavier, stronger, has greater belt power—equal in accuracy to any lathe built. Write for Free Catalog. Easy Payment Plan if desired.

South Bend Lathe Works
525 E. Madison St. South Bend, Ind.



The coagulation of the contained solid matter by means of chemical treatment

of the diluting material absorbed by it in use.

In the new process which we will now describe, the solid matter and the absorbed motor fuel or gasoline are removed in two distinct operations. The difficulty of emulsification is entirely avoided, and the gasoline is completely removed, so that the oil is entirely restored to its original body as a new oil. The difficulties mentioned in the treatment of ordinary crankcase drainings are overcome entirely. The first operation is the removal of the solid matter by a chemical washing and settling treatment. The second is the removal of absorbed gasoline by steaming at a relatively high temperature.

The successful treatment of an oil having a strong tendency to emulsify, depends upon the discovery that emulsification of the oil with the treating solution does not occur so long as there is no contact between the two in a free liquid surface, such as where there are bubbles of steam or air passing through the intermingled liquids. The contact necessary to obtain the coagulating action is obtained by introducing the treating solution beneath the surface of the oil in a broken stream, in the center of the treating tank. The solution passes down through the oil, settling out at the bottom, where it is withdrawn as fast as it enters, to be returned above and to pass again through the oil. This produces a circulation of the oil, down in the center and up around the outside, so that the entire mass of oil is brought into contact with the solution. There is also a tendency to leave the coagulated solid material at the bottom of the oil in this circulation, on account of the relatively slow motion in the outer parts, where the oil is rising. The liquids are heated before the washing is begun, and kept hot not only during the washing, but long enough afterward to permit the solid material to settle while the oil is thin, as it is, while hot.

This part of the process is illustrated in the accompanying diagram. *A* is an electric disk heater, for heating the contents of the tank; a gear pump is shown for taking the solution from the bottom up to the nozzle above, from which it passes down through the oil in a broken stream. After the treatment and settling, water is run in below to run off the cleaned oil, which passes over the upper rim of the tank, into an annular part marked "oil overflow rim." This is open at the top, as is the tank, allowing the oil to pass over, and permitting easy access and visual inspection of the oil as it comes over. From the overflow rim, a spout drains the oil to a receiving vessel. The sludge is best removed by dipping, after the last of the oil has been run off. On account of its thick, sluggish nature, much labor in cleaning is avoided by keeping the sludge out of the overflow rim as far as possible. Arrangement should be made to catch the oil stream in a separate vessel on the first appearance of the least particle of the sludge, so that the oil previously run off remains entirely clean.

In the diagram, *B* illustrates the apparatus used for getting rid of the kerosene-like constituents of the gasoline that have been absorbed by the oil. The removal of these constituents, known as the "heavy ends" of the gasoline, completes the reclamation of the oil. The oil is heated up to a temperature of 350 to 380 degrees, Fahrenheit, and from the time it is a few degrees above the boiling point of water, steam is blown through it. Any water coming over with the steam is caught in the water trap, and the steam is at the same time superheated to the temperature of the oil. The exact temperature to which the oil should be heated depends upon the drainings and upon the body desired in the reclaimed oil, the body, or thickness of the oil increasing with an increase in the temperature. When the oil has reached the right temperature, the heat and steam are shut off, and the oil is allowed to cool, when it is ready for use. Care must be taken not to shut off the heat from the steam generator without admitting air to the steam line leading to the oil tank; otherwise, the condensation of steam within the generator will draw over the oil, into both the water trap and the steam generator. Three quarts or more of the good oil will be recovered from four quarts of ordinary drainings.

A simple apparatus that has been found very effective for treating small quantities of oil is shown in the first half-tone. The washing is carried out in a ten-quart pail, provided with a spout at top and an outlet with shut-off cock at the bottom. The upper tank contains washing solution. The flow of solution from the upper tank is regulated by a cock, and the flow from the ten-quart pail is regulated so that it just balances

that from the upper tank. The solution is caught in the pail below, which is occasionally emptied back into the upper tank. After an overnight settling, the clean oil is run out of the pail as illustrated in the second halftone, by forcing water into the bottom of the pail of treated oil, thus floating it up.

The steaming tank is made of a five-gallon kerosene can. A well-crimped and soldered can has been found to hold, although the solder softens at temperatures to which the oil is raised, but all joints of this tank were brazed, for safety.

* * *

Can Stars Be Seen by Daylight?

FROM time to time within recent months we have noted numerous letters in various scientific publications, concerning the visibility of stars in the daytime, especially from wells and mine shafts. There seems to be considerable misconception in this connection. Thousands of people have seen one of the planets, Venus, in broad daylight, but Venus is not a star. Stars are not visible to the naked eye, either from the bottom of a well or from a silo. They are too faint.

In a recent issue of *Popular Astronomy*, (March, 1926, Northfield, Minn.), Prof. C. C. Wylie of the University of Iowa makes out a rather amusing case against the alleged daylight visibility of stars. Professor Wylie had previously challenged the oft-repeated assertion that certain stars could be seen from the bottom of silos. In reply an Indiana reader then made the claim that if the Professor would come to his home he would convince him of his error by taking him to a 70-foot silo. "I myself have plainly seen Ursa Major, Algol and Capella in the early afternoon of a September day," he wrote, naming the exact date of their observation.

The Professor suggests that someone try this experiment in agricultural astronomy in September, since Ursa Major at the time named was 45 degrees from the zenith, and he says he doubts whether the silos in that region lean at a 45-degree angle! Also at the date and hour named, Capella and Algol were below the horizon. He then explains the customary manner of showing a curious and eager amateur astronomer the stars from the bottom of a silo. Of course the man cannot see the stars, so he is coaxed to lie down and view the sky upward through an empty coat sleeve, the coat being well wrapped about his head. A bucket of cold water is then poured down the sleeve.

Professor Wylie then makes the following unequivocal statements:

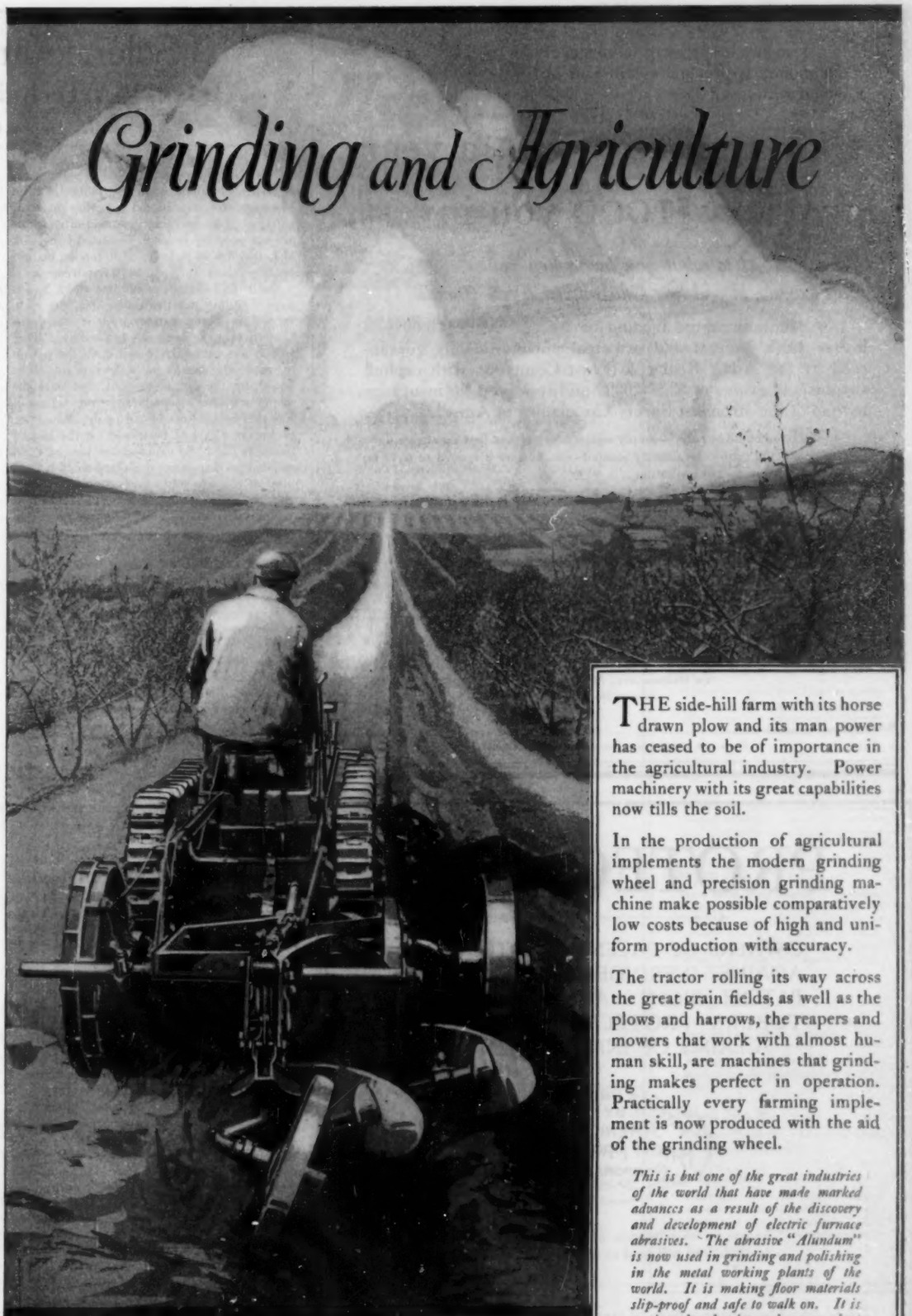
"1. Men with years of experience in mine work report never having heard of anyone seeing a star by daylight from a mine shaft.

"2. The silo, or mine shaft, does not change the contrast between star and sky background. The telescope changes it hundreds of times. From daylight work with a telescope it can be computed that Venus is the only 'star' bright enough to be so seen without changing the contrast.

"3. Daylight observation of Venus from rooms with high southern windows indicates it must be about 30 times as bright as Vega to be observed by day without optical aid.

"4. In the evening, the fixed stars are noticed from a high window of a darkened room, or from a silo, at about the time they can be seen from anywhere out of doors.

"As far as I know, no observations have been taken especially to answer this question. We have many facts gathered in connection with other work; but considering the number of educated people ready to believe stories such as this one from Marion County, Indiana, it would seem worth while for some one with access to a high silo, a mine shaft, or a tall chimney, to make a few observations. I would suggest the observation of some bright zenith star, such as Vega, when it is on the meridian in twilight. Record first, the time it is seen over the silo or chimney, and second, whether it can be seen from outdoors immediately after noting the time. Continue until the star is lost in daylight."



THE side-hill farm with its horse drawn plow and its man power has ceased to be of importance in the agricultural industry. Power machinery with its great capabilities now tills the soil.

In the production of agricultural implements the modern grinding wheel and precision grinding machine make possible comparatively low costs because of high and uniform production with accuracy.

The tractor rolling its way across the great grain fields; as well as the plows and harrows, the reapers and mowers that work with almost human skill, are machines that grinding makes perfect in operation. Practically every farming implement is now produced with the aid of the grinding wheel.

This is but one of the great industries of the world that have made marked advances as a result of the discovery and development of electric furnace abrasives. The abrasive "Alundum" is now used in grinding and polishing in the metal working plants of the world. It is making floor materials slip-proof and safe to walk on. It is serving the chemist and power plant engineer in the form of laboratory ware and refractories.

NORTON PRODUCTS
Grinding Wheels-Refractories
Grinding Machines-Floors

Norton Company
Worcester, Mass.
New York Chicago Detroit Philadelphia Pittsburgh

BAUXITE PLANT: Bauxite, Arkansas
ABRASIVE PLANTS: Niagara Falls, N.Y., and Chippawa, Ont.
GRINDING WHEEL PLANTS: Worcester, Mass.; Hamilton, Ont.; La Courneuve, France; Wesseling, Germany

Can any investment offer more?
Your money is precious—will you be satisfied with less?

A Guarantee of $65 a year for every $1000 you invest!

That is what you buy when you buy Adair Guaranteed 6½% Bonds

An uninterrupted income of $65 for every $1000 you invest—both interest and principal unconditionally guaranteed by the Adair Realty & Trust Company, with capital, surplus and profits of $2,500,000—and approved for insurance by one of the strongest Surety Companies in America.

No bond could be safer—amply secured by a closed first mortgage upon income producing properties, ideally located—backed by a record of over 60 years without loss to any investor.

Mail the coupon today for detailed information and current offerings.

ADAIR REALTY & TRUST CO. *Founded 1865*

CAPITAL, SURPLUS AND PROFITS, $2,500,000

Healey Building, ATLANTA Packard Building, PHILADELPHIA

ADAIR REALTY & MORTGAGE CO., *Inc.*
270 Madison Ave., New York City
Ownership Identical

Name..... *Address*.....

Dept. SA-3 Please send full information about Adair Guaranteed Bonds

PROTECTION

OWNERS OF PATENTS PROTECTED AGAINST INFRINGEMENT OF THEIR PATENT RIGHTS AND MANUFACTURERS PROTECTED AGAINST CLAIMS OF INFRINGEMENT

PATENTS PROTECTED BY AMERICAN PATENT PROTECTION CORPORATION

The use of this insignia on letter heads and in advertisements will tend to ward off patent troubles

The faithful performance by us of every contract we issue is also guaranteed by the Independence Indemnity Company, with assets of $8,000,000

AMERICAN PATENT PROTECTION CORPORATION

Incorporated under the laws of the State of New York

25 BROAD STREET
NEW YORK

Science and Money

Bonds—A Technical Consideration

By Henry C. Trundle

FINANCIAL expediency has brought many types of bonds upon the market. First investors are bewildered by the maze of varieties in security offerings, and often funds are not properly invested because of the lack of knowledge of technical differences, market considerations and personal requirements.

Until the Liberty Loans came along, bonds were familiar practically to only the rich. As a part of the war program it was desirable to interest everyone financially. Likewise it was necessary to call upon the person of moderate means to subscribe to these Loans, for the rich alone could not raise the money required to conduct the war. Thus it was that bonds were issued in denominations as low as $50, and even sold on the partial payment plan. So new was the idea of bond ownership, that many neglected to cash their interest coupons and others considered their purchases purely as gifts to their country.

Huge amounts of Liberty Bonds were sold rapidly, revealing a new type of investor. Capitalizing their experience, financiers adopted the policy of issuing bonds in $100 and $500 denominations, as well as in the usual $1,000 pieces.

Quite naturally the obligations of one's country are regarded by its citizens as of the choicest quality. In the United States, in the British Empire or in other countries of good financial standing, therefore, government securities will be found to be selling higher than any other class of domestic offering. The credit of nations is based upon the ability to levy and collect taxes sufficient to pay expenses and interest. If the national wealth is large and if the government is fundamentally sound, the safety of such issues is unquestionable and will be reflected in the market price.

Wide Fluctuation in Foreign Bonds

The unfamiliarity of investors with the resources, customs and people of foreign countries makes it necessary to induce Americans to extend a credit through higher rates of interest or other considerations. War threats and declining money values, et cetera, recently have caused much apprehension to the holders of foreign bonds, resulting in wide fluctuations in price. Only in a few instances in the history of foreign loans, however, has actual default occurred. As it may be necessary to seek external credit again, nations see to it that their outside debts are paid, whatever action they may take regarding their internal obligations. Bankers are sincere in their statements that investors will realize too late that in the present years many opportunities were offered them in foreign government and industrial bonds to obtain exceptional security and high yields at ridiculously low cost. Already some of these bonds are selling 10 and 20 points above their levels of a year or two ago.

Those who do not like United States Government securities because of their low returns or foreign bonds because of their uncertainties, but who do prefer the obligations of governmental bodies find in state, county and city bonds both the safety and the income yield they desire. Such bonds are purchased principally by persons living within the borrowing districts, and have therefore a limited market.

Possibly the next preferred investments are real estate and railroad bonds. This department has only recently discussed the excellent character of real estate mortgages, so we will turn to the latter type. Huge sums were required to finance the building of transcontinental rail systems and the money was obtained at then very attractive rates. Because of the scarcity of investment opportunities, and the large potential earnings capacity of the companies, railroad securities soon gained for themselves a strong position which as a class has been maintained.

The outgrowth of railroad development and national progress has been industrial expansion and consolidation. Money requirements for these were larger than the private fortunes of the business builders. The public therefore put up the necessary capital, accepting as security the bonds of the companies. The hazards of business are such, however, that all investments in industrial bonds have not turned out well, finally, nor have they been entirely satisfactory during the time of ownership. Depressions in specific lines, competition, or errors in management policy are frequent enough so that it is absolutely necessary that investors consider carefully their proposed commitments and that purchases of industrial issues be moderate in relation to the total account.

Public Utility Bonds

Dependent somewhat on industry, and yet not enough to encounter difficulties in hard times, the business of public utility companies is remarkably stable. The services provided by such companies—electricity, gas, water, transportation and ice—are essentials of every day life, and as these are provided practically without competition, full opportunity is given to build up a large earning power. In contrast to the history of railroads, public utilities have been developed with legislative approval, avoiding the expense of legal entanglements. They now are conducted under the general supervision of state commissions, which fact is assuring to the cautious. Electric and gas plants and water works operating under local management in small communities are being replaced by interconnected systems which take in hundreds of cities and which are directed by men of great administrative and financial experience. The service obtained is better and cheaper. To accomplish the necessary consolidations and to finance the new constructions billions of dollars are required. Bond offerings of public utility companies have been in profusion in recent years and future requirements appear to be as great.

In principle, the first mortgage is the best security, although it is evident that the promise to pay of one person might be better than the secured obligation of another person. A first mortgage bond has a first claim on the property of the company, as well as upon the earnings. Usually mortgages are placed to only 50 to 80 percent of the property valuation. In earlier times it was customary to limit the amount of bonds that could be issued through a "closed" mortgage. This has hindered development because it has been impossible under the terms imposed to use additions and betterments as collateral for further financing. It is the modern method to have "open end" mortgages which allows companies to issue bonds up to say 80 percent of the total property valuation, provided earnings conform to certain requirements.

Such names as "First and Refunding," "First Lien and General," "Collateral Trust" and "Debenture" are frequently used in modern financing, but bonds so named may not actually be as well secured as they appear. Due to the inability to always be able to place a first mortgage on a property because of prior encumbrances, and due to the aversion to second or tenth mortgages, such mortgages are camouflaged through the titles "First and Refunding," et cetera. An analysis will show that the first claim is only on a small part of the property, the real

security being a junior claim on the balance. In complex situations it is preferable to deposit bonds and/or stocks of constituent companies and issue a "Collateral Trust" bond against them. They may therefore be in effect a first mortgage and can be purchased safely with discrimination. "Debenture" bonds are the unsecured obligation to pay, and are used by companies with strong credit or by those with no assets to pledge.

An entirely new development is the "Equipment Trust" Certificate which is used by railroads and motor bus companies to finance the purchase of rolling stock. If these certificates are issued under "The Philadelphia Plan," they are generally regarded as of prime quality. Under this Plan, the company pays down say 20 percent of the cost in cash and retires a certain amount of the certificates each year. Title to the equipment is vested in a trustee until final payment is made. The company is required to keep the equipment in good condition during the life of the loan. It is evident, then, that the equity is increased as fast as the certificates are paid off. In other words, there might be but $100,000 of certificates outstanding, secured by equipment worth two or three million dollars. In the event of default it is a simple matter to run the locomotives, freight cars or busses over to a new purchaser and receive payment for the indebtedness.

Exercise Your Conversion Privileges

All companies cannot find a buyer for their securities with the same readiness, nor at the same favorable price. It then becomes necessary to add features which will carry an appeal sufficient to attract investors. The disadvantage of low returns from government and municipal bonds is overcome through their being tax-exempt. Another familiar feature is the right to convert into stocks. For instance, the Debenture Bonds of one company were sold to the public at a price of 100. Convertible into common stocks these bonds attained a price of 172, fluctuating in direct relation to the common stock quotations. Incidentally, millions of dollars have been lost by investors who failed to exercise their conversion privilege, or who neglected to sell their bonds prior to the expiration of such rights. This loss is inexcusable since every effort is made by companies, newspapers and investment houses to bring this matter to the attention of the bond holders.

Still another feature which is used extensively is the right to redeem the bonds at a price several points above par, either by call by lot, or by redemption in part or as a whole. This option is inserted by companies which believe they can borrow on more advantageous terms at a later date. This feature has made it possible for investors to speculate mildly, without in any way considering their investments as a speculation. For example, $2,300,000 Kingdom of Belgium 7½s are drawn by lot for payment each June at 115. These bonds at one time sold in the 80's and if one was lucky, one could have had his bonds paid off at 115, and purchased others of the same issue at say 85, a clear gain of $300 per bond. At no time during these transactions was there any change in security value. Bonds with this feature were in demand and many companies were thus enabled to finance themselves.

Sometimes instead of conversion privileges or attractive call features, a bonus in the form of shares of common stock is given with each bond. Or a warrant may be attached giving the right to purchase stock at a fixed price within a certain period. The purchasers of one such bond were recently agreeably surprised to find that they could sell their warrants for more than the original cost of the bond and they were further fortunate in having their bonds called for payment at 104. As interest had been paid at the rate of six percent in the meantime, the investment turned out to be most profitable.

Many of the preceding points have little

To Crate Users Weyerhaeuser now introduces "Cut to Size" Crating Lumber

ON top of the savings they have already effected for the industrial men of America, Weyerhaeuser now comes forward with a still further contribution toward economies in crating and transportation costs.

Briefly, it is this:—

To the manufacturer who has standardized, or who can standardize, his crates, Weyerhaeuser is prepared to furnish Crating Lumber *Cut to Size.*

This Weyerhaeuser *Cut to Size* Crating Lumber is of standard kind and grade as specified for the individual crates. It is cut to the required length, width and thickness for each individual crate and is shipped in bundles ready to assemble.

A Carload of Lumber is about 25,000 Board Feet. Buy your Crating Lumber from Weyerhaeuser *Cut to Size.*
All good crating pieces.
No waste.
No dead freight loss.
No labor cost for cutting up in your shipping room.

Weyerhaeuser *Cut to Size* Crating Lumber is prepared only at the Weyerhaeuser Mills. It can be supplied only in carload lots. And each car contains all the pieces needed to make a specified number of standard crates.

There will always be some manufacturers and shippers who will find it necessary to buy their crating lumber in bulk and do the cutting up in their own establishments, and to these Weyerhaeuser offers a dependable supply of *ideal, light weight* woods in grades best suited to their purpose.

But the man who can and will follow the Weyerhaeuser Crating Service every step of the way, including this new *Cut to Size* offering—may expect *Eight Specific Savings* (and maybe Nine) as enumerated in the right hand column.

It is worth thinking about. We invite your correspondence.

Savings

Saving No. 1
No freight on waste. You pay freight only on the finished pieces, the waste that develops in the cutting up process is disposed of at the source.

Saving No. 2
Lower lumber costs per crate. Weyerhaeuser *Cut to Size* Crating Lumber is cut at Weyerhaeuser owned mills. Therefore, a Weyerhaeuser *Cut to Size* Crate is strictly a "one profit" crate.

Saving No. 3
Lower labor cost per crate. Weyerhaeuser *Cut to Size* Crating lumber is worked up by men who specialize in doing this one thing for hundreds of customers. In most cases, therefore, they can do it better and cheaper than the individual customer can do it for himself.

Saving No. 4
Lower overhead cost because it cuts the "no profit" operations of a shipping room to a minimum. It releases valuable space for *profit making.*

Saving No. 5
Less weight per crate. Weyerhaeuser crating lumber is ideal for crating purposes—strong, easy-working, non-splitting but also *light in weight* and that saves freight cost on your shipments.

Saving No. 6
Less lumber per crate. Weyerhaeuser Crating Engineers know how to build *efficient* crates with a *minimum of lumber*—often 10% to 30% *less lumber* than many shippers formerly used. And that saves again on shipping weight.

Saving No. 7
Fewer adjustments and claims for damaged shipments, because a Weyerhaeuser designed crate is not only stronger but specifically better protection for the merchandise packed in it.

Saving No. 8
The good will value of an efficient, good appearing package.

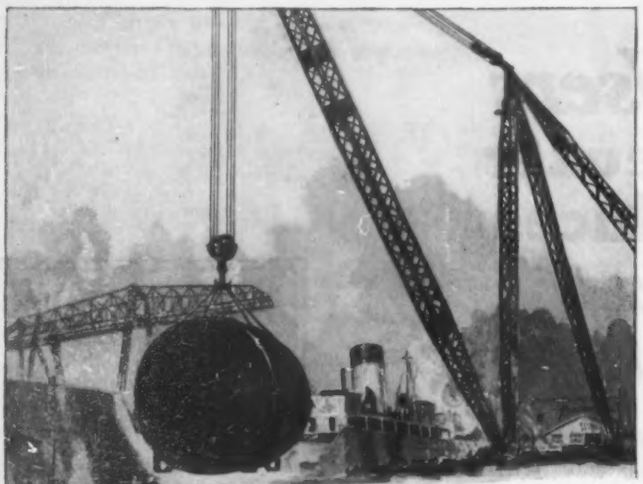
Saving No. 9
Many times, a Weyerhaeuser designed crate has given the shipper the advantage of a more favorable freight classification and that means a lower freight rate.

WEYERHAEUSER FOREST PRODUCTS
SAINT PAUL · MINNESOTA

Producers for industry of pattern and flask lumber, factory grades for remanufacturing, lumber for boxing and crating, structural timbers for industrial building. And each of these items in the species and type of wood best suited for the purpose.

Also producers of Idaho Red Cedar poles for telephone and electric transmission lines.

Weyerhaeuser Forest Products are distributed through the established trade channels by the Weyerhaeuser Sales Company, Spokane, Washington, with branch offices at 208 So. La Salle St., Chicago; 220 Broadway, New York; Lexington Bldg., Baltimore; and 806 Plymouth Bldg., Minneapolis; and with representatives throughout the country.



Sinews of Industry

Without wire ropes, Industry would be muscle bound—almost helpless.

With wire ropes, the crane, derrick, elevator, donkey engine become *flexible* handling devices of inconceivable value.

For 50 years, Broderick & Bascom Wire Ropes have been serving Industry faithfully and well. Yellow Strand Wire Rope is the highest of all high grade ropes. When developed 30 years ago, it established a new standard which has never been excelled. The strand painted yellow is your protection.

This company also makes all standard grades of wire rope for all purposes.

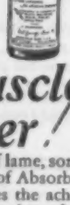
Motorists

Carry a Baseline Autowline in your car and safeguard your spare tire with Powersteel Autowlock. Both are made of Yellow Strand. Ask your accessory dealer.

BRODERICK & BASCOM ROPE CO.
843 North First Street, St. Louis, Mo.
Eastern Office and Warehouse: 76 Warren St., New York City
Western Office: Seattle *Factories:* St. Louis and Seattle
Authorized Dealers in all Industrial Localities

Yellow Strand WIRE ROPE

JR581



Keep your muscles limber!

WORK the stiffness out of lame, sore muscles with applications of Absorbine, Jr. *The magic bottle* quickly takes the ache away from tired muscles — makes them feel new again.

Absorbine, Jr. wakes up the circulation. It combats congestion. Before you know it you are fit again for work or play.

Absorbine, Jr. is equally effective for tired feet—blisters—callouses—cuts and bruises.

At all druggists', $1.25, or postpaid
Send for free trial bottle

W. F. YOUNG, Inc., Springfield, Mass.

Absorbine Jr.
THE ANTISEPTIC LINIMENT

Protection Doubly Assured

BEFORE investing your surplus funds, take the precaution against loss by seeking the expert and conservative advice of your local or investment banker who will gladly serve you.

Eliminate the Loss in Investments

For after all good investment opportunities predominate. Caution, Care, Investigation will reveal safe and profitable channels for your surplus funds.

The Financial Article that appears in the May issue of *Harpers Magazine* will help solve your investment problems.

Harpers MAGAZINE

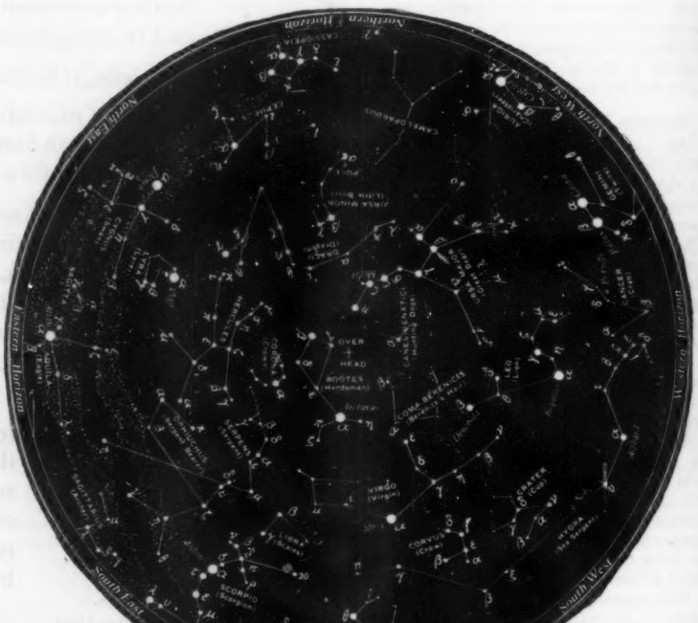
49 East 33rd Street, New York, N. Y.

meaning for the ordinary investor, who seems to concern himself only with price and yield. These factors are based directly on security, marketability and other specialized features such as tax exemption or legality for investment of trust funds. Another determinant of price in the case of United States Government bonds is the specialized use, for instance, to which they are put by banks in securing circulation of money. Many railroad bonds are "legal for investment" for certain funds and have therefore a demand in excess of their actual investment attractiveness; that is, they are purchased in preference to industrial or public utility issues of equal quality or of better income yield simply because the latter bonds cannot be purchased due to restrictions by law. On the other hand, bonds for which there is no specialized demand, or those issued by small companies, may sell far below their intrinsic worth giving a high yield. It is a fallacy, also to consider "listed" as more safe than "unlisted" bonds, and investors frequently pay through a smaller return for the privilege of seeing daily in the newspapers the records of transactions. In most cases "the market" for listed and unlisted bonds is exactly the same—the investment house sponsoring the issue—and it makes no difference if the dealings are published or not. The security is not improved nor does the listing of a bond create a market of itself.

In order to build up a satisfactory account, investors should analyze their individual requirements and make selections to conform to them. Diversification in type, in maturity, in marketability and in geography will in most cases avoid risks and insure the maximum benefits of safety and income.

The Heavens in May

By Professor Henry Norris Russell, Ph. D.



At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.

At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

At 9¼ o'clock: May 30

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

THIS month, we find Saturn in the southeastern sky, just to the left of the star Gamma Librae (marked on our map) and a little below it. The planet is so much brighter than the star that it will take a second glance to detect the latter.

Perhaps an easier way to identify the planet is to look for it a little above the line joining the bright stars, Antares and Spica and much nearer the former.

Scorpio and Virgo are in the south. Above them is Boötes, and below is Centaurus, whose brightest stars, pointing westward toward the Southern Cross, can be seen at this season from points within the tropics.

Leo is in the west and Hydra in the southwest. Gemini and Auriga are setting in the northwest. Ursa Major, Draco and Ursa Minor are high in the north. Cygnus and Lyra are in the northeast and Aquila in the east, with Hercules higher up and Ophiuchus in the southeast.

The Planets

Mercury is a morning star all the month and is easily visible at its beginning, rising at about 4:15 A.M. He remains in sight till the middle of the month, and is then gradually lost from the observer's sight when dawn steals across the sky.

Venus is also a morning star, rising about 3 A.M. in the middle of the month and is very conspicuous. Mars rises much earlier —near 1 A.M. at the beginning of the month —but still counts as a morning star. Jupiter gets above the horizon about midnight and is conspicuous in the early morning. Saturn is in opposition on the 14th and is to be found as already described. Uranus rises about 2 A.M. and Neptune sets near 11 P.M., so that neither is very well placed for observation.

The moon is in her last quarter at 10 P.M. on the 4th, full at 6 P.M. on the 11th in her first quarter at noon on the 19th, and full at 7 A.M. on the 27th. She is nearest the earth on the 7th, and farthest away on the 19th.

During the month she is in conjunction with Jupiter on the 5th, Mars on the 6th, Uranus and Venus on the 8th, Mercury on the 10th, Neptune on the 18th, and Saturn on the 26th.

Another Solution to the Grade Crossing Problem

We think that Mr. Ward has hit upon a very workable solution of an important problem. We happen to know that the same idea embodied in his letter is now in operation at one of the railroad crossings on the Long Island Railroad; and, in our opinion, it is such an excellent system that we wonder that it has not been installed at more crossings.

Scientific American,
Gentlemen:

I read your article in the August issue of the Scientific American entitled, "Saving the Motorist from Himself," and inviting the inventive minds of the country to help solve the problem.

I have been thinking over this since reading the article, and have figured out a device that appears to me to be feasible and yet not too expensive to install and keep up at all-important crossings.

The device consists of a storage battery placed at or near the crossings (within easy access of the highway or railroad employe who has charge of the installation and up-keep) connected by a wire running through water-proof conduits back from the crossings both on the highway and the railroads to a point about 500 feet with a switch under the railroad track so as to make a contact when a train is passing over it. The lines extending along the highway should have red lights placed on posts, so as to be easily seen by the motorist when the lights are flashed on, either day or night. The lights should be spaced about 100 feet apart, along both sides of the highway, so that the motorist can not help but see them when they are flashed on.

The lights need not be large, but might be similar to the automobile headlight, only red instead of white.

A train approaching a crossing from either direction, when within 500 feet of the crossing would pass over the point of contact with the battery and immediately flash on the red lights along the highway on both sides of the crossing. The lights would remain on until the train was 500 feet beyond the crossing, or until the train had passed over the other point of contact.

The idea of having the lights extend back from the crossings 500 feet both on the highway and railroads is to give the motorist ample time to bring his car to a stop before reaching a crossing after the lights have been flashed on. Should he be too near the crossing to do this when the lights are flashed on, he would probably have time to get past the crossing before the train reached it, as the train would be 500 feet away when the lights came on.

Then, farther back down the highway, signs could be placed, warning the motorist that he was approaching a railroad crossing.

No other signs of any description should be placed within this zone to detract the attention of the motorist from the crossing signs, unless it should be found necessary to place a road marker within the zone.

If 500 feet will not extend far enough back at crossings on railroads that run very fast trains, the point of contact could be placed far enough back from the crossing to make it safe.

The cost of installation and up-keep of this type of crossing signal should not be prohibitive, and could be divided equally between the railroads and the highway department.

If this type of crossing signal were adopted as a standard the country over, the motorist would soon become familiar with it and would always know when he was approaching a railroad crossing, no matter in what part of the country he was traveling.

The motorist from Washington or Oregon driving in Florida would be as familiar with the railroad crossings as he would be in his own state.

W. W. Ward,
Dublin, Georgia.

A Correction

Some of the cares of an editor and an evidence of the possibility of making errors despite the utmost caution, is shown by the following:

Editor,
Scientific American.

In an article of mine published in your March issue dealing with the peace uses of war gases, I note a rather unfortunate error. The article gives the impression that CN and cyanogen chloride are the same thing, when as a matter of fact, the only property they have in common is that both will produce tears. CN is the abbreviation usually used to designate chloro-aceto-phenone

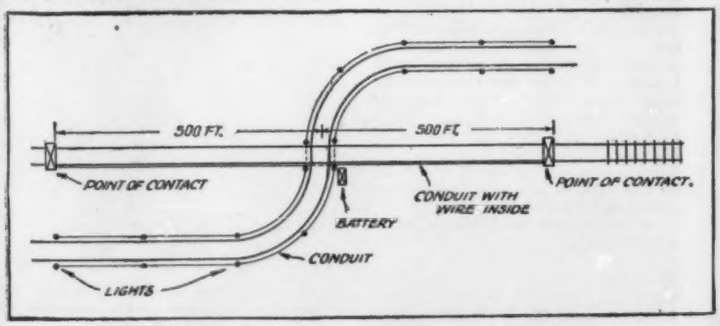
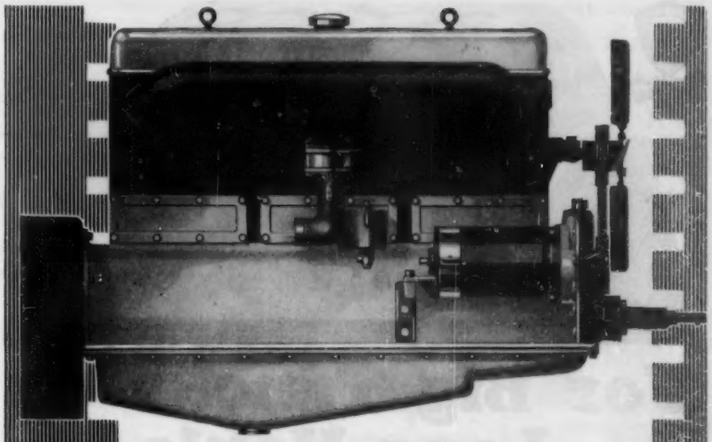


Diagram of lighting system for crossing signal



Easy on the Gas Tank!

WHERE profits depend much on ton-miles-per-gallon, Wisconsin's extra mileage on fuel and oil quickly climbs into a real money saving.

And these great motors *do* deliver this good measure. Their More Power per Cubic Inch is borne out day after day—by every model in the Wisconsin line of overhead-valve Fours and Sixes.

Wisconsin has taken the highly efficient overhead-valve principle and steadily refined and developed it—made it deliver more than it ever did before.

The facts are interesting and convincing. They will be sent gladly to any executive. Write—

WISCONSIN MOTOR MFG. CO.
MILWAUKEE WISCONSIN

MORE POWER per CUBIC INCH

Wisconsin Motors are manufactured in a full line of Sixes and Fours, with power range from 20 to 120 H. P.—for trucks, busses, tractors and construction machinery.

Wisconsin CONSISTENT

For Big Trucks on Long Hauls

Your big trucks on long hauls with few stops should be equipped with Non-Skid Hi-Type tires. Their performance, while meeting severe haulage conditions has proved their all-around ability to deliver long mileage, cushion the truck, and give sure hold of the road in various types of service.

The prime reasons for long mileage are the design which allows the tires to keep cool readily—and the tough resilient compound—both especially suited to long distance work. The formation of the broad tread insures safe, efficient road traction.

Learn more about this special tire for heavy haulage and the fine record it is making. See your nearest Firestone Service Dealer—Today.

MOST MILES PER DOLLAR

Firestone

NON-SKID HI-TYPE TIRES

AMERICANS SHOULD PRODUCE THEIR OWN RUBBER H. S. Firestone

MEN WANTED

to manufacture Metal Toys and Novelties. No salesmanship necessary. Demand exceeds supply and we co-operate with you in selling goods, also buy them from you. We put you in touch with the buyers. Guaranteed casting forms with complete outfit furnished for speedy production of Toys, Novelties, Ash Trays, Bookends, and other big all year sellers. Absolutely no experience or machinery necessary. No special place needed. Small investment puts you on road to success. You do the manufacturing and we take care of the selling. Act immediately if you want to handle big line wholesale orders now being placed. Strictly a business proposition. Catalog and information mailed on request.

METAL CAST PRODUCTS CO.
1696 Boston Road New York

Ice Making and Refrigerating Machinery
Corliss & Poppet Valve Engines
Bulletins sent upon request
THE VILTER MFG. CO.
899 Clinton Street Milwaukee, Wis.

PATENT FOR SALE

American and Canadian patent rights on a new metal folding chair. Address, Box 168, Scientific American.

MALLEABLE CASTINGS
Rough or Machined

We specialize on machined malleables in quantity production. Many users who operate large machine shops in connection with their business find it to their advantage to buy of us. Perhaps you could do likewise.

Ⓑ

BENTON HARBOR MALLEABLE FOUNDRY CO.
Benton Harbor Michigan

A Book That Will Help Solve Your Sawing Problems

If you are interested in the use of mechanical saws either for wood or metal work, you should have a copy of the Huther Catalog No. 46. It illustrates and describes a complete line including Dado Head, Inserted Tooth Milling Saws, Cutter Heads, High Speed Knives and Mitre Saws.

This book does not illustrate any hand saws but to those whose work requires the use of mechanical saws, we shall gladly send a copy of this book free when requested on business stationery.

Huther Bros. Saw Mfg. Co.
Rochester, N. Y.
Makers of Better Saws for More Than Fifty Years

A simple method of working out the frets on a stringed instrument

which is widely used as a tear gas. CN is a solid substance, and hence is easily handled in a variety of ways for producing tears. Cyanogen chloride, on the other hand, is a very volatile liquid which is quite difficult to handle. It is produced in the United States Public Health Service method of fumigation by hydro cyanic acid by adding a small amount of bleaching powder to the sodium cyanide-acid mixture used.

The impression that I attempted to convey in the article in question was that there are many substances which can be used for the same purposes among the war gases, and that each of these has properties which make it particularly suitable for various uses.

I trust that you will be willing to give space to the correction of this error.

Truly yours,
D. H. Killeffer.

Out of Style

"It takes all kinds of people to make a world," and strange indeed are some of their ways. We are under the impression that this peculiarly shaped head acquired by an old Indian tribe wouldn't go well with our modern fashion for bobbed hair—perhaps that's why this custom of the Clayoquets is no longer in vogue. Our correspondent writes us thus:

Dear Editor:

The Clayoquots, an Indian tribe on the West Coast of Vancouver Island, British Columbia, were formerly distinguished by the unusual and artificial shape of their skulls. During infancy a peculiar and unnatural elongation was produced by placing a board or cradle secured by cedar bark tapes on the head and allowing it to remain there until the desired conformation was obtained. There appears to have been no mental impairment nor did the natives seem to be inconvenienced by their devotion to an extraordinary fashion. While the habit has been discontinued long since, our illustration of an elderly squaw—obtained with great difficulty at Quatsino village by Mr. B. W. Leeson (H. M. Canadian Customs)—gives an excellent idea of an ancient native custom.

T. W. S. Parsons,
British Columbia.

Is This an Original Method?

When strumming an instrument at some time you may have wondered how the frets were located. Here is a very simple method:

Editor, Scientific American,

Dear Sir:

I recently had occasion to lay out the frets on the fingerboards for some stringed instruments. After inquiring in a number of places and consulting the public library without results, I got out the old Physics book and figured out a method of laying these out to give the Chromatic Scale on any string.

The following is a description of the method which is easy and accurate and mathematically correct.

Lay out a right-angle triangle whose altitude is slightly less than 35 percent of the base (.349813 was the figure I obtained). From the acute angle, which represents the bridge, layout a distance equal to the length of the given string, with this length as a radius strike an arc cutting the hypothenuse, from this intersection drop a perpendicular to the base; this will be the location of the first fret. With this as a radius strike a second arc and perpendicular giving the location of the second fret. Continue to the twelfth fret which should fall exactly in the middle of the string. It will, if the layout has been accurately made. The second octave either above or below can be laid out by continuing in the same manner.

The angle was determined as follows:

The 1st fret = cosine $\angle \times$
The 2nd fret = (cosine $\angle \times)^2$
The 3rd fret = (cosine $\angle \times)^3$
* * * *
The 12th fret = (cosine $\angle \times)^{12}$

This also equals one-half the string, therefore (cosine $\angle \times)^{12} = \frac{1}{2}$ or cosine $\angle \times = \sqrt[12]{\frac{1}{2}}$ I found this to be .9437638, making the angle about 19°-18'-50". The tangent of this angle gives the altitude of the triangle.

I made this layout on the polished surface of a bakelite panel using scratch lines and then transferred the locations to the fingerboard of the instrument.

On the actual instrument the distance from the twelfth fret to the bridge must be slightly greater than that from the twelfth fret to the other end of the string as depressing the string increases the tension and the higher notes would be too sharp.

J. M. Dockstader,
Perth Amboy, New Jersey.

Let's Go!

From a prospector "in the bush," as they say in Australia, comes a letter which is of interest in that it gives us not merely an insight into the rather unusual underground quest for the beautiful black opal, but an insight into the thoughts of a reader in the antipodean continent which lies "down under." The writer wants our readers to

The shape of this skull is not the product of nature but is procured by artificial means

pack up and leave for a prospecting trip in New South Wales.

It is curious how few people have seen an opal. The man in the street considers it unlucky, but to the opal miner it is unlucky only when he has none in his possession. Most people are under the impression that the diamond is the most costly precious stone, but a "dinkum" black opal will bring many times the price per carat of the finest diamond; and those who have seen the magnificent display of colors in an opal gem will agree that it far surpasses all other precious stones in loveliness.

The finest class of opal is the black opal, which has a black background, and shows beautiful red, green, orange or blue flashes, or a combination of these, in fact all the colors of the spectrum. Lightning Ridge is world-famous for its black opals.

The geological features of Lightning Ridge are very interesting. There is on the surface, which is much eroded, a thin layer of weathered conglomerate with rounded quartz pebbles reminiscent of an old sea beach. This layer is nowhere more than a few feet thick, and in many places is totally removed. Beneath this comes a stratum of fireclay, baked like the "biscuit" of porcelain, and varying from a few feet to eighty feet in depth. This stratum has been subjected to considerable heat, and overlies a stratum of red sandstone about ten feet thick. Under this sandstone is a remarkable, thin layer of very hard sandstone, called by the miners "steelband" because of its hardness. This layer is very thin, and in some places is missing. Its greatest thickness is about five inches, except in folds and contortions which it often shows. The next stratum below the "steelband" is also a fireclay which varies in thickness.

The opal is found in the "steelband" and in the foot or two of fireclay below it. It seems as if the solutions carrying the silica of the opal had come down through the sandstone at points or cracks, and formed the "steelband" in irregular layers between the standstone and the fireclay below it, saturating also the clay for a foot or two in depth, and forming "nobbies" or chunks of opal in both. It is well known that a layer of basalt produced by volcanic action once overlay this country. This basalt probably supplied the heated solutions which produced the effects visible in these beds of clay and sandstone. Red iron oxide is in evidence almost everywhere.

It must not be imagined that opal occurs always as clear gemstones. The gemstone free from sand is the exception, which accounts for the rarity and costliness of black opals. Then also, black opal occurs in large knobs which show no color, and are therefore valueless. It is heartbreaking to see stones worth hundreds of pounds ruined by sand inclusions. Such stones often show the most beautiful flashes of red and green, but the stone when faced shows sand and dirt, which spoil its appearance.

The equipment necessary for mining is extremely simple. Just a windlass and buckets and picks and shovels complete the gear. A house in this beautiful climate needs only a roof. The sides are better open. The air is like wine, and the cost of living low. Opal mining offers the best prospecting chances in the world; for, at least, you can always make the cost of your "tucker," and there is a chance of a strike worth thousands of pounds. Strikes up to ten thousand have been made on this field from single claims one hundred feet square.

If you have never seen black opals I counsel you to visit your jeweller forthwith. For as Ella Wheeler Wilcox has it, the gem is a child of the marriage of the sunbeam and the moonbeam, a thing of surpassing loveliness.

M. S. B.
Lightning Ridge,
New South Wales.

Where quantities of black opals are mined

A Splendid Antidote for "Blue Monday"

The letter herewith has given us particular joy—because it comes from a "brother in the trade." From experience, he knows some of the problems which an editor has to work out in an effort to put into the hands of his

KEYSTONE COPPER STEEL

Steel Sheets that *Resist Rust!*

THE destructive enemy of sheet metal is *rust*. An alloy of copper gives to Steel Sheets and Tin Plates the highest degree of resistance to rust and corrosion. Keystone Copper Steel gives maximum endurance—a fact proved by actual time and weather tests. Demand Keystone quality for lasting service.

Apollo

BEST BLOOM GALVANIZED SHEETS
APOLLO-KEYSTONE *Copper Steel* GALVANIZED SHEETS
CULVERT, FLUME AND TANK STOCK
FORMED ROOFING PRODUCTS

Black Sheets for all Purposes

AUTOMOBILE SHEETS—ELECTRICAL SHEETS
DEEP DRAWING AND STAMPING STOCK
TIN AND TERNE PLATES

Apollo Galvanized Sheets, made continuously since 1884, are the best known Galvanized Sheets produced. An additional factor for permanence has been added in Apollo-Keystone grade by the use of Keystone Copper Steel for the base metal. This copper-steel alloy is particularly adapted for roofing, siding, gutters, spouting, flumes, culverts, tanks, and all sheet metal work requiring highest rust-resistance. Keystone quality demonstrated its excellence in service tests of American Society for Testing Materials. Could you ask for more thorough or impartial proof? Sold by leading metal merchants. We shall be pleased to assist the trades in the solution of problems involving the use of Sheet and Tin Mill Products. Send for *Facts* booklet.

Sheet Mill Products

Black Sheets for all purposes, Apollo and Apollo-Keystone Copper Steel Galvanized Sheets, Culvert and Tank Stock, Formed Roofing and Siding Products, Special Sheets for Stamping, Automobile Sheets, Electrical Sheets, Stove and Range Sheets, Barrel and Keg Stock, etc.

Tin Mill Products

American Coke and American Charcoal Bright Tin Plates, Taggers Tin, American Old Style and American Numethodd Roofing Terne Plates, MF Roofing Tin Plates, Black Plate for all purposes: Enameling Stock, Stove Pipe and Elbow Stock, Special Stamping Stock, etc.

American Sheet and Tin Plate Company

General Offices: Frick Building, Pittsburgh, Pa.

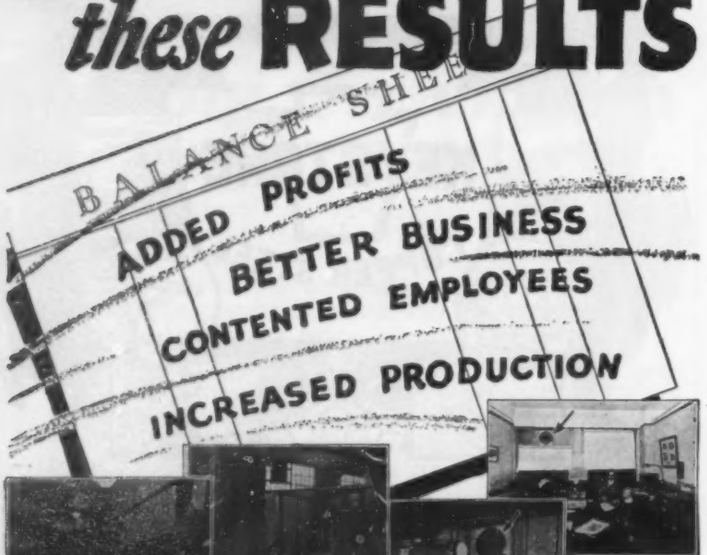
DISTRICT SALES OFFICES

Chicago Cincinnati Denver Detroit New Orleans New York Philadelphia Pittsburgh St. Louis

Export Representatives: UNITED STATES STEEL PRODUCTS CO., New York City

Pacific Coast Representatives: UNITED STATES STEEL PRODUCTS CO., San Francisco, Los Angeles, Portland, Seattle

Take the Fresh Air route to these RESULTS



In offices, factories, garages and shops, American Blower Ventilating Fans make working conditions pleasant and comfortable regardless of outside weather conditions—and they increase production per man.

They have their effect on sales, too. Customers enjoy buying from wide awake, intelligent clerks in cool and fresh places of business—crowds throng to the well ventilated theaters—and goods are fresher looking in places where soot and dirt are carried away by American Blower Ventilating Fans.

American Blower Ventilating Fans are made in various sizes and types to care for every ventilation need. They are the result of years of experience by the American Blower Company—an organization that has been a leader in the scientific development and manufacture of air handling equipment for over 45 years.

For complete information, prices and advice on American Blower Ventilating Fans, write direct to the factory or ask your electrical dealer.

AMERICAN BLOWER COMPANY, DETROIT
BRANCH OFFICES IN ALL PRINCIPAL CITIES
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

516-B

American Blower

"Sirocco" VENTILATING, HEATING, AIR CONDITIONING, DRYING, MECHANICAL DRAFT
Manufacturers of all Types of Air-Handling Equipment — Since 1881

readers a magazine which is attractive, not only from a standpoint of interesting reading matter, but also from a standpoint of arrangement of material, pleasing and informative illustrations, easily read type, and so forth. Thank you, Mr. Gage!

Editor Scientific American, (the Make-up Editor in particular.)

I have just finished reading the December issue of your always-welcome publication, and feel moved to strongly endorse what Edward N. Lake wrote you, as printed on page 429.

It *is* much more satisfactory to the reader of your pages not to be obliged to "skip all over the lot" to get the whole of an article, yet your advertisers do not need to feel that they are thereby in any wise handicapped, for you very skilfully keep up the interest all through the publication, and one page is as good as another.

I am a printer of over forty years' experience, so can appreciate the tremendous amount of work involved (including the intelligent use of the blue pencil) in making your contributed articles "come out" just page length. But the effect is *fine*.

I make no claim to being "scientific" in any sense of the word, but the fine discernment shown in making scientific articles easy of comprehension to the lay mind, (such as "Plating Rubber" for instance) gives your publication, with its acknowledged voice of authority, a most unique position among the publications which come into our home—29 of them every month.

Years ago, the old form of the Scientific American while in some degree interesting, made reading its pages more or less of a task. In your present form it becomes a pleasureable delight.

One other matter—purely technical. I readily appreciate why you do not use enameled paper on the publication, but believe you might select a stock which would print your halftones better, and yield more detail. As an instance, the "open safety pin" in the plate at top of page 381. In *my* copy the safety pin is hardly discernible. I believe there is more detail in the plate than shows.

At any rate, I have "got it off my chest" and will close by giving you my hearty congratulations on the exceedingly high-class publication you are putting out.

Fred W. Gage,
Battle Creek, Michigan.

Adventurous Birds!

From one of our Scottish readers, Mr. E. O. Catford, of 6 Royston Terrace, Edinburgh, comes an interesting item.

It seems that high on the "hooter" of the Edinburgh Corporation Tramways Depot a sparrow built her nest and laid in it three eggs, to the accompaniment of loud "hoots" which sounded forth from the horn four times daily. In fact, one of the young birds fell out of the nest when the hooter was sounded one day. The other two were successfully reared, and—we should imagine—they must be so immune to noises that they could live quite happily amid the nerve-wracking noises of New York.

Our photograph shows the hooter and the nest. The wooden shelter which ordinarily protects the horn from rain was removed in the interests of a good photograph.

Sparrows select an unusual location for their nest

The Traffic Problem in Remote Siam

Evidently we're not the only nation concerned with traffic problems. This letter from Allen Bassett of the Prince Royal's College at Siam, describes a method put into practice there in an attempt to diminish the number of accidents:

Chiengmai, Siam.

Editor,
Scientific American:

Your article on "Saving the Motorist," by H. W. Slauson, was of keen interest to me as just now, because of the increasing number of motor accidents here, we are experimenting with means to save him and his victims.

The device that sounds so simple that it was laughed at when presented has gone a long way toward solving the problem.

The method used is simply to put strips of raised paving (about two feet wide and curving to a height of ten or twelve inches in the center) at intervals across the road approaching a danger point. These strips may be negotiated only at slow speeds with comfort and give an absolutely inescapable warning of danger ahead.

They have proved so effective in Siam that the accidents have been diminished by more than 80 per cent.

Allen Bassett.

Tradition

What a mighty thing is a long honorable record! How this appears from both sides is shown by the following letter:

Scientific American.
Gentlemen:

I have been a reader of the Scientific American for some 40 years. I recently saw a page from the Scientific American of the year 1872, illustrating and describing the Bradley Cushioned Power Hammer which we put on the market that year, and which we still make and market.

I haven't a doubt but what my father and grandfather were subscribers to and readers of the Scientific American from its birth in 1845. Our business was established here in 1832.

I know that I have read it for more than 40 years, in fact it is the first paper or magazine I remember. My boys read it now and no doubt my grandchildren will some day, in case they are boys.

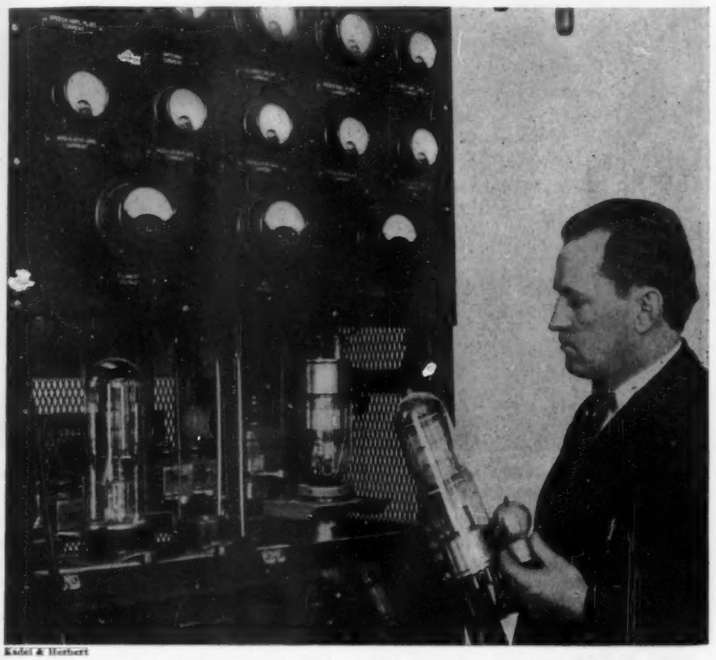
Wishing every, and continued, success, I am,

Yours respectfully,
C. C. Bradley, Jr., President,
C. C. Bradley & Son, Inc.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.



Kadel & Herbert

The heart of WHAP, New York. This is the Manhattan station which bans jazz, advertising and propaganda from its microphone. The wavelength is 240 meters

Observations Show Aurora Blameless

IT is a question whether or not the aurora borealis has an ill effect upon radio. Observations to date, however, indicate that the Northern Lights are not a disturbing factor so far as radio is concerned. The effect upon very short waves is not fully determined.

During this year's international broadcasting tests there was an aurora borealis phenomenon which interfered with telegraph traffic. The earth currents picked up by the wires reached a potential as high as 150 volts. The disturbance was chiefly noticeable on grounded circuits; but the full metallic long-distance telegraph and telephone lines which had no connection with the earth did not pick up the strange current.

The northern display apparently has a peculiar effect upon waves under 100 meters in length, but not upon the higher waves. During the January aurora, commercial short-wave stations could not communicate across the Atlantic. Everything seemed to go "dead." Low-wave receivers in England failed to detect the 41-meter signals from WGY as on the two previous nights. The British authorities, however, scarcely felt that the aurora was affecting the regular broadcasting channels from 200 to 550 meters, because they could not hear the transmitters in the United States on the other nights of the test when the aurora was not visible.

The statement that "auroral phenomena acts like a blotter on the air; it mops up everything," is contrary to conclusions reached by experts who have made a study of the aurora and its effect upon Hertzian waves.

Dr. Donald B. MacMillan, who made it a point to study the aurora and radio in the Far North, came back from an arctic expedition in September, 1924, and said, "The aurora borealis apparently has no effect on radio transmission or reception. We even passed right through the aurora belt and it did not trouble the radio waves

International Newsreel

Sub-sea telephone receiver. The U. S. Navy is testing under-water wireless in the Potomac. Conversations have been carried on for a distance of two miles

"The little wrinkle that makes my 'B' batteries last longer is using the right size Eveready with a 'C' battery"

"I USED to think that because the Eveready 'B' Battery No. 772 cost less than either of the larger Heavy Duty Evereadys that I was saving money. As a matter of fact, on four or five tube sets, that was false economy.

"The right size Eveready 'B' Batteries to use depends on the number of tubes in your set. The life of the batteries depends on how much you listen in and on whether a 'C' battery is employed."

To get the maximum of "B" battery life and satisfaction, follow these simple rules:

On 1 to 3 tubes—Use Eveready No. 772.

On 4 or more tubes—Use the Heavy Duty "B" Batteries, either No. 770, or the even longer-lived Eveready Layerbilt No. 486.

On all but single tube sets—Use a "C" battery.*

*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed to permit the use of a "C" battery by any competent radio service man.

Follow these rules and No. 772, on 1 to 3 tube sets, will last a year or more; Heavy Duties, on sets of 4 or more tubes, eight months or longer.

The average year-round use of a set is two hours a day. If you listen longer your "B" batteries will have a somewhat shorter life. If you listen less they will last just that much longer.

Our new booklet, "Choosing and Using the Right Radio Batteries," is free for the asking. It also tells about the proper battery equipment for the new power tubes.

Manufactured and guaranteed by

NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night means Eveready Hour—9 P. M., Eastern Standard Time, through the following stations:

WEAF—*New York*
WJAR—*Providence*
WEEI—*Boston*
WTAG—*Worcester*
WFI—*Philadelphia*
WGR—*Buffalo*
WCAE—*Pittsburgh*
WRAI—*Cincinnati*
WEAR—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO—*Minneapolis, St. Paul*
KSD—*St. Louis*

LEFT—*No. 486, for 4, 5 or more tubes.* $5.50.

RIGHT—*Eveready Dry Cell Radio "A" Battery, 1½ volts.*

EVEREADY
Radio Batteries
—they last longer

As it should be

SINCE its extra cost, when spread over its billions of output, figures to but three cents per package of twenty, it is quite fair to say that Fatima, in between 'costly' and 'popular' in price, is decidedly more popular than costly

FATIMA

"What a whale of a difference just a few cents make"

LIGGETT & MYERS TOBACCO CO.

INVENTIONS PERFECTED
MODELS MADE
In a fully equipped machine shop
Manufacture Dies, Tools, Jigs and Fixtures of Precision
Let us manufacture and act as your factory
Moore & Co. 301 W. Grand Ave. Chicago, Ill. Est. Dec. 1819

FREE HERE'S MORE MONEY for YOU
150 Home-Study Books
Each of these sure pay raising, self-help books is a complete course of instruction. They cover Electricity, Automobile, Machine Shop, Carpentry, Painting, Engineering, Railroading and twenty other trades. Full catalogue FREE. A postcard brings yours.
F. J. Drake & Co., Publishers
1005 Michigan Avenue, Chicago

LANGUAGES
WORLD-ROMIC SYSTEM. MASTERKEY, 5000 languages. Primers, $1.98; Chinese, French, Spanish. Dictionaries, $1.98. Languages Pub. Co., 8 W. 40 St., New York.

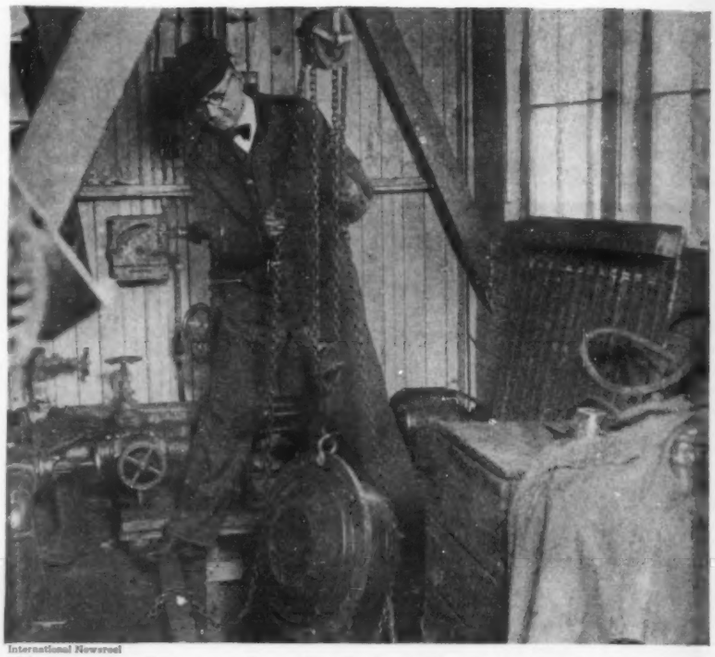
Trade Old Golf Balls For New

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.

LEARN WATCHWORK JEWELRY WORK AND ENGRAVING
A fine trade commanding a good salary and your services always in demand or you can start in business for yourself. At
BRADLEY INSTITUTE
The greatest school for watchmakers in the world. Address Horological Dept. H, Bradley Polytechnic Inst., Peoria, Ill., for our latest catalogue.

Universal Flexifour 10-15 M.P. MOTOR
YOU'LL wonder how such power and pep can be packed into so tidy a bundle! Flexifour is wonderfully compact—yet very accessible—easy to care for. New 1926 refinements, coming on the heels of its 1925 gain of 25% more power on 10% less fuel, make Flexifour HANDIER, simpler, smoother, surer to start and run. Get the facts and figures! Mention size of your craft.
UNIVERSAL MOTOR CO.
47 Cesape St. Oshkosh, Wis.

INGERSOLL
DOLLAR STROPPER
ROBERT H. INGERSOLL, originator of the famous Ingersoll Watch, offers you his remarkable new invention that brings back original keenness to used blades, makes them last longer and gives cleaner, smoother, more comfortable shaves. Already satisfying thousands of users.
Hundreds of Shaves From Every Blade
The Ingersoll Dollar Stropper keeps razor blades practically as good as new—hundreds of shaves from every blade! That means no more discarding blades after a few shaves. Resharpen them and save $5 to $10 a year!
TEN DAYS' TRIAL
If you cannot get it at your dealer's, send $1.00 for complete outfit with 12-inch Strop and patent nickel-plated Holder. Automatically puts scientifically keen edge on blade. Money-back guaranteed if ten-day trial doesn't convince that Mr. Ingersoll's new invention solves your razor-blade troubles. When writing, mention make of razor used.
DEALERS: Write for proposition.
Robt. H. Ingersoll, Pres. New Era Mfg. Co.
Dept. 865 476 Broadway, New York City



International Newsreel

The ear of under-sea wireless. Dr. E. B. Stephenson, physicist of the Naval research laboratories, lowering the sound detector into the waters of the Potomac

in the least. After we passed through the aurora belt the display was no longer northern lights, but a southern light."

Reports from wireless operators at ship and shore stations substantiate MacMillan's statement. Spectacular displays of the aurora in 1919 completely crippled Canadian and New England telegraph lines, but radio operators on ships off the New England coast and the shore stations noticed no bad effects.

Heaven-wide displays over Lakes Superior and Huron in 1917 were so strong that they waved back and forth across the sky and reflected on the water like moonlight; but the range of transmission and reception by radio on the Great Lakes was not affected, nor did the waving curtains of varicolored light stir up an increased amount of static.

Canadian Amateurs on 52.51 Meters

WEDNESDAY evening is set aside by Canadian amateurs for the free exchange of trans-Canada traffic on a wave that is assigned to bring all amateurs together. During the winter of 1924-25, the 120-meter wave was used. When the Canadian amateurs convened in Montreal at the American Radio Relay League convention in November, they petitioned the Government for a new wave band nearer to the amateur short-wave channels. In response to this request they have been assigned the 52.51-meter channel.

In order to be sure that all wave meters and transmitters are properly calibrated, the Government broadcast tests on the 52.51-meter wave from Ottawa.

Likes and Dislikes of Radio Fans

INTERESTING facts regarding the likes and dislikes of the radio audience were revealed in the answers to 4,000 questionnaires circulated by the management of station WJZ among listeners, who wrote to that station reporting on the reception of the 50-kilowatt transmitter at Bound Brook, New Jersey. The object of the questionnaire was to obtain information useful to the impresario in planning programs.

Courtesy of the General Electric Company

A piece of quartz crystal less than an inch square, ground to a thickness a shade less than an eighth of an inch, controls the frequency of WGY's 50-kilowatt transmitter. There is not a fractional departure from the assigned wavelength. At the left is the crystal amplifier, which houses the quartz crystal and the exciting tube. At the right is a stage of intermediate amplification. The engineer is holding the quartz crystal and the metallic chamber in which it is enclosed

Classical music was 33 percent more popular than jazz.

More than three times as many reported that they used outdoor antennas as those who use antennas inside the home.

The answers revealed that orchestral music is the most popular, with bands, symphonies, violin, organ and piano following in order. Vocal quartets are far more popular than vocal trios. In the vocal solo field the contralto received the majority of votes, with soprano second and bass third.

In the service end of the broadcasts, news led by more than 25 percent. Time signals and sports ranked second and third respectively. Stock reports were fourth, road conditions, fifth, and agricultural information, sixth.

Baseball led as the most popular sports broadcast in the United States. Baseball was 10 percent higher than football, which ranked second. The Canadian questionnaires placed hockey first, horse racing second and baseball third.

Travelogues ranked far ahead in the field of talks. Scientific topics were second, with other subjects voted for as follows: politics, health, literature, economics, art, debate, forum and beauty.

Few objected to programs sponsored for good-will publicity, and the majority who voted for this type of program justified their vote by explaining that entertainment promoted by advertisers improves the quality of the broadcasts.

In answer to a question regarding interference, there was an overwhelming complaint against radiating receivers, which act as miniature transmitters and annoy neighbors.

The questionnaires clearly show that male announcers are preferable to women announcers. The general complaint directed to announcers was that they did not give the station's call frequently enough. Other suggestions regarding announcers was that they stop trying to be funny; be brief and stop broadcasting lengthy descriptions of selections and the life-story of the composer.

Church services on Sunday won the praise of many who answered the questions. Quite a number specified their religion but did not express a desire for any particular denominational service on the radio.

Most of the listeners reported that their homes are wired for electricity and that they are lighted by 110 volt, 60-cycle alternating current. Those who reported on direct current were in the minority.

Stimulating Sales of "B" Eliminators

THE Potomac Electric Power Company of Washington, D. C., is offering "B" battery eliminators on a cash payment basis as an inducement to radio set owners to purchase the current supply devices. The payments are added to the monthly electric light bills.

The Electric Company has adopted the slogan, "Run your radio from your house current." The devices cost about fifty dollars. They enable the radio listener to use the house-lighting current instead of batteries.

Arc Discontinued

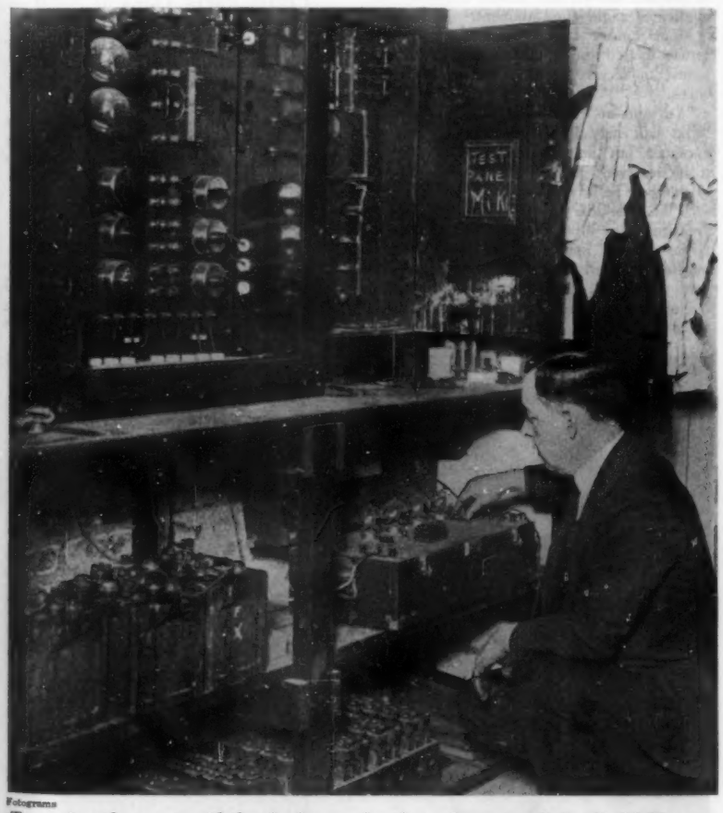
THE 30-kilowatt arc transmitter at the Great Lakes Naval Training Station has been discontinued because broadcast listeners complained of interference created by the arc. Traffic from the Great Lakes Station is now being handled on 34 meters.

Underground Wires Make Good Aerials

PAPERS prepared by Commander A. Hoyt Taylor, of the United States Navy Radio Research Bureau, and Lieutenant A. Crossley, appearing in the proceedings of the Institute of Radio Engineers, explain some of the results obtained with underground antennas.

The navy men said, "It has been shown that it is possible to receive efficiently signals from stations at any wavelength, long or short, using submerged or subterranean wires, provided that one or more stages of amplification are used.

"The relative advantage of ground-wire reception on short waves lies in the ability



Fotogramo

Two microphones, to aid the deaf, are placed on the stage of the Guild Theatre, New York, to pick up the words of the actors and forward them to the amplifying equipment in the basement. Wires lead to a row of seats where plugs are located with earphones. A small control is placed at the side of each seat, so that each person can regulate the volume

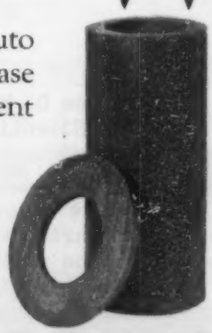
"It's So—
But D— If I'll Believe It!"

"WHEN they installed those bearings twenty years ago, they said they didn't need any oil. I've been waiting every day to see 'em burn up. But they ain't done it yet."

Do you believe that any bearing can run for 20 years without a drop of oil? Do you believe you can buy a bearing like that for one-sixth the price of bronze?

If you don't believe it, we can't blame you. But there *is* such a bearing. It is called the Arguto Oilless. And if you care to be convinced—just drop us a line.

Actual experience shows that Arguto Oilless Bearings effect a 300% increase in the life of a power belt—prevent slipping and eliminate belt dressing as well as the labor of applying it.



ARGUTO OILLESS BEARING CO.
Wayne Junction Philadelphia

OILLESS BEARINGS

Arguto

ARGUTO OILLESS BEARING CO.
Wayne Junction, Philadelphia, Pa.

Please send information and facts about Arguto Oilless Bearings.

Name .....

Address .....

City and State .....

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

WOOLWORTH BUILDING
233 Broadway, N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

TOWER BUILDING
Chicago, Ill.

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents
and Trade-Marks by Request.
Associates in All Foreign Countries.

AN OPEN REPORT

SCIENTIFIC AMERICAN
Woolworth Building
New York

Mr. Orson D. Munn,
Editor Scientific American.

My dear Mr. Munn:-

We are pleased to report that Mr. Porter's recent articles on "Telescope Making" and Mr. Ellington's "More Houses of Mud" have produced an unprecedented sale for Amateur Telescope Making and Modern Pisé Building.

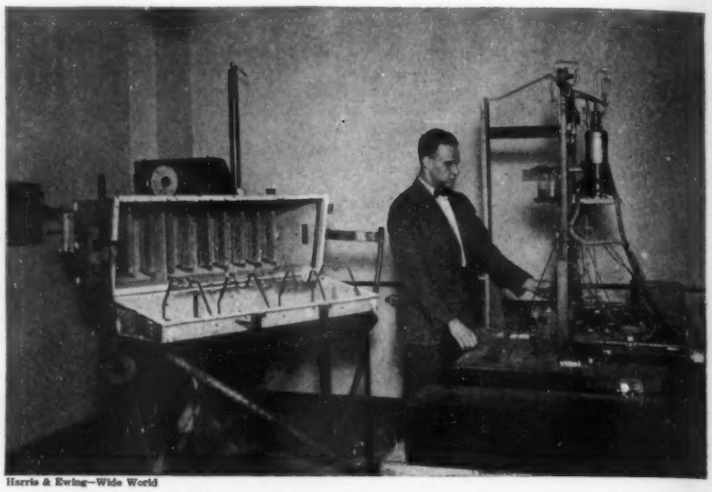
The orders for these books reached us in such volume that it was necessary to employ additional help to take care of them. While there has been some delay in getting the orders out, we have now about cleared matters up.

This will help to explain any complaints that may reach your desk.

By your instructions we have priced Amateur Telescope Making at $2.00 postpaid and Modern Pisé Building at $2.65 postpaid.

Respectfully,

BOOK DEPARTMENT.



Harris & Ewing—Wide World

Experimenting with vacuum tubes. This vacuum tube pump belongs to the Bureau of Standards, and is employed for discharging air and gases from the bulbs

of the receiving operators to continue to copy messages through violent electrical storms without danger to themselves and with little or no interruption of traffic.

"Reception in fresh water or wet soil is superior to that of bare wires above or on the surface or in dry soil. As the wire is lowered into the water or into the wet ground, the signals increase. Ground wires have a high degree of directivity which can be utilized for shutting out interference from a neighboring source. Static is minimized."

Radio Has Won Noted Artists

RADIO during the past winter season won many noted artists to the microphone, prominent among them Schumann-Heink, John McCormack, Lucrezia Bori, Mary Garden, Louise Homer and Charles Hackett. All seem to have been attracted to the radio studios under the auspices of advertisers. Thus, the desire to get the name of a firm or product known has greatly improved the quality of radio entertainment.

Mme. Louise Homer was asked whether artists missed the applause they are accustomed to receive from concert stage audiences.

"Yes and no," answered the prima donna. "The hall may be filled with a storm of applause, but the artist alone knows whether it is deserved; and if not, for one reason or another, he is very conscious of it.

"Praise is dear to all of us, whether we are singers or ditch diggers; but if we ourselves do not know whether the praise is merited we shall never be able to accomplish very much that is worth while, whether it is singing an opera or digging a ditch. Even when outbursts of applause are later supplemented by the choicest adjectives of newspaper critics, I know whether it is deserved."

There have also been many leading bands and orchestras on the air during the past season. Outstanding among them has been Henry Hadley's Philharmonic, which won considerable applause and caused much favorable comment among radio fans. The Philharmonic playing the "Angelus," composed by Mr. Hadley, was one of the bright spots of the 1925-26 radio season.

Nine Argentine Stations

TWO more broadcasting stations are radiating into the air of the Argentine. Both are located near Buenos Aires and the power output of each is 1,000 watts. One uses the call LOT and the other LOO. The former broadcasts on 272.7 meters and the latter on 250 meters. Buenos Aires now has nine radiophone stations.

Prefer Farm Talks at Noon

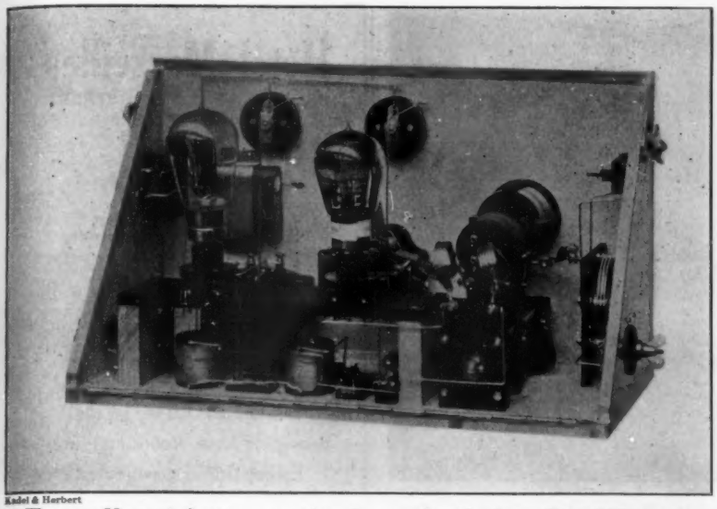
A NUMBER of farmers have asked the Department of Agriculture to broadcast the agricultural reports from WRC and WCAP, Washington, at noon instead of at 7 P.M. It is argued that such information received at noon would be most helpful to the farmers, and furthermore, it would not break into the entertainment which city listeners tune for early in the evening.

Says Future Plays Will Be on Radio

COSMO HAMILTON, who is doing much to develop the radio novel, recently said, "I think that radio will be used by dramatists long after the theatre as an institution has

Harris & Ewing—Wide World

The laboratory of the Bureau of Standards has designed and built an apparatus whereby the wavelengths of radiophone stations may be measured to determine if they are on their exact wave channels



Kadel & Herbert

The new Marconi short-wave receiver for wavelengths from 15 to 100 meters

been shut up; and the shutting up of the theatre is undoubtedly a fact which we shall have to face.

"The experienced dramatist who has been in the habit of writing himself into three acts will have to reconstruct his technique and write himself into one act and then write himself down finally into fifteen minutes. I believe that half the dramatists of the day are retiring because they cannot compete with the changes that are going on in the theatre. The thing we are striving for is a concise form of writing—the elimination of every unnecessary word."

Radio Workshop Aids Parts Business

AMERICAN stores may find a good suggestion in the radio workshop installed in the Selfridge and Company store in London. There, radio fans can build their own radio sets under the guidance of an experienced radio electrician. The system has been named "Wireless without Tears."

The workshop is open daily except Saturday in two sessions, from two to four o'clock and from four to six o'clock. Tickets for admission are obtainable from the radio department of the store. There is no charge for the service.

Canadians Organize

CANADIAN radiophone stations have joined in a new organization known as the Canadian Association of Broadcasters. The announced purpose of the association is to improve the standard of broadcasting, to promote the interests of the broadcast auditors, and to spread by means of radio a wider knowledge of Canada, its advantages and opportunities.

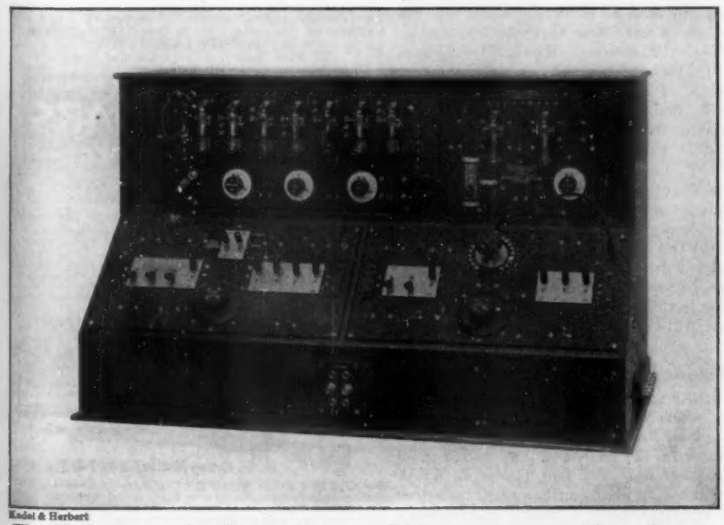
The organization was prompted by the insistence of the music copyright owners that the broadcasters should take out licenses from them and pay license fees. J. N. Cartier, of station CKAC, is president of the association.

Strive to Improve Expositions

NEW YORK has an unfortunate situation so far as radio shows are concerned. Two factions, one representing New York interests and the other controlled by Chicago interests, staged two shows on Manhattan Island last September, and both were in progress at the same time. One show would have been enough. Comment heard among radio fans after the expositions last autumn showed that the consensus of opinion was that it would be the best thing for the radio industry if the two show factions would bury the hatchet and come to an agreement whereby one big show of concentrated effort could be held in New York under one roof, thereby eliminating duplication of effort on the part of the exhibitors.

Present plans call for two New York shows in September again this year, one at the Grand Central Palace and the other at the new Madison Square Garden.

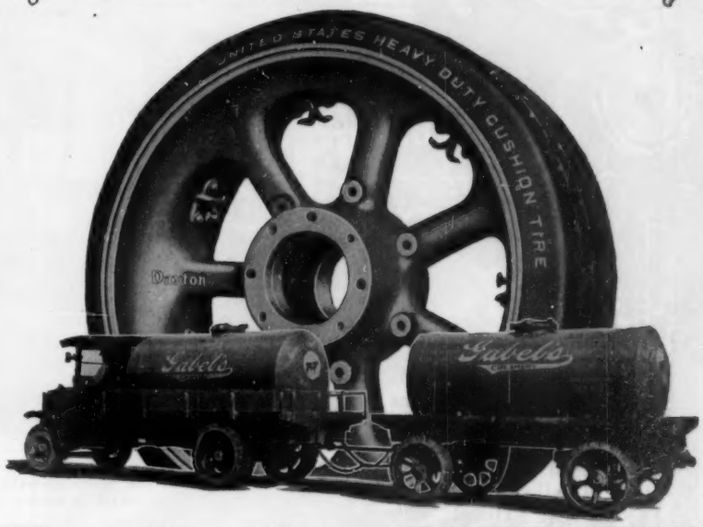
A radio exhibition corporation has been organized by several leading manufacturers to make a general study of the radio show



Kadel & Herbert

The Marconi general utility receiver, type RG5, comprising amplifying detector, low-frequency magnifier, aerial tuning circuit unit, and closed circuit tuning unit. It was designed to meet the requirements of those who need an efficient and selective receiver to cover an extremely wide range of wavelengths with the simplest possible adjustments. Three hundred to 30,000 meters can be manipulated by the veriest novice

STRENGTH ~ LIGHT WEIGHT ~ DURABILITY



Fruehauf *uses* DAYTONS

The trailer doubles the earning capacity of the truck. It is significant that most trailers are equipped with Dayton Steel Wheels. Daytons help to cut down the added pull on the motor and the increased fuel expense by their true roundness.

Terrific shocks and knocks will not put them out-of-round. Super-strength and light weight make them the ideal wheels for the trailer.

That's why the Fruehauf Trailer and nearly all the leading makes of trucks use Dayton Steel Wheels. Specify them.

THE DAYTON STEEL FOUNDRY COMPANY
Dayton, Ohio

Dayton
Steel Truck Wheels

TIRE ECONOMY ~ ACCESSIBILITY ~ APPEARANCE

Shave Electrically

You can't imagine how smooth and pleasant your morning shave can be until you try the new Vibro-Shave Electric Safety Razor. Its electrically operated blade, vibrating 7200 times a minute, is the secret of this new, scientific method of perfect shaving.

Send us $10.00 today, and we will send you the complete outfit, including face and scalp massage attachments, five blades, cord and plug, attractively boxed. Your money refunded without question within five days if you are not satisfied.

Vibro-Shave blades last three times as long as ordinary blades

For Use With 110 Volts Alternating Current Only

RAZOR PRODUCTS CORP.
1440 Broadway Dept. B
New York

Write for illustrated circular

Geneva Binoculars

This Model $19.50

Free! **World's most Complete Binocular Catalog, showing 58 Styles**

Prices $9.50 to $106. Powers (Magnification) from 4 to 24. Illustrates and describes every style clearly. Explains how to select a glass for touring, hunting, night use, sports, ranching, etc. Tells of Geneva patents, which increase field of vision over old styles.

Everybody Is Buying a Binocular

1924 was a wonderful Binocular year. 1925 still bigger. 1926 will be biggest of all. Select glass you prefer and have us send it on 10 days' trial. No obligation. Write for free catalog. Postal will do.

GENEVA OPTICAL CO., 71 Linden Street Geneva, New York

WRIGHT HOIST UNIT

There are 21 reasons why you should not be without this super-hoist unit, (I-Beam, Trolley & High Speed Hoist) with its 21 points of superiority.

Let us tell you about each one?

WRIGHT MANUFACTURING COMPANY

Lisbon Ohio

WRIGHT
IMPROVED HIGH SPEED HOIST

New hand Telescope *Aseros* with variable magnifications from 4 to 20x $140

Same with Table stand or Tripod $174

ZEISS
Telescopes

For terrestrial and astronomical observations. From the smallest hand telescope to the largest observatory type.

Zeiss optics can be supplied to those desiring to build their own telescopes.

At leading opticians, camera- and sporting-goods stores.

Write us for information and catalog.

CARL ZEISS, Inc.
Formerly Harold M. Bennett
153-A West 23rd Street, New York

Gen'l. Dist. Agts. for Canada: The Hughes Owens Co., Ltd. Montreal Toronto Ottawa Winnipeg

Harris & Ewing—Wide World

Testing radio coils. This is the laboratory of the Bureau of Standards in which answers are found for the many questions asked about the various types of coils used as tuners in receiving sets

situation, especially in New York. It is understood that the exhibition corporation will strive to have only one show in New York.

R. M. Klein, General Manager for F. A. D. Andrea, Inc., announced the general purpose of the association. "The general object is to insure radio shows that will be put on in a manner to bring the greatest benefit to the public, to the radio manufacturers and to all elements having the best interests of the radio industry at heart. Promoting shows for the benefit of an individual or group of individuals will be discouraged. The public is entitled to first consideration in this matter."

Most Stations Operate on Low Waves

THE majority of broadcasting stations in the United States are operating on wavelengths between 205 and 278 meters. On wavelengths above 278, there are not more than four stations with the same wavelength.

The 275-meter channel is the most congested. It has 26 stations. There are 24 transmitters on the 250-meter wave; 23, on 278; 19, on 253 and there are 15 stations on each of the following waves: 225, 231, 234, 242 and 248.

Fifteen stations are rated with power outputs of 5,000 watts and higher. Seven stations have exclusive wavelengths, and out of the seven, two have outputs of 5,000 watts or more; four are between 500 and 5,000 watts and one is under 500 watts. The majority of transmitters are rated at 500 watts or less.

British Audience Growing Fast

RADIO set owners in the British Isles now total approximately 2,000,000. During the past year the number has grown at the rate of about 50,000 a month.

Weather Man Shy of Static Forecast

THE weather man is shy of forecasting static or radio atmospheric conditions. The United States Weather Bureau has been asked to undertake forecasts pertaining to radio reception a night or two in advance—that is, whether reception would likely be poor, fair, good or excellent. But the officials of the Bureau contend that the relation between radio reception and meteorological conditions is too indefinitely established and too many other variable factors are involved to justify a service which would necessarily be uncertain.

Professor C. F. Marvin, Chief of the Weather Bureau, when asked why the Government could not issue a daily radio forecast said, "I feel it would be unwise to attempt a new work of this sort in a hit-and-miss way and that we should not do so until the subject has been investigated thoroughly and systematically and we are convinced a worth-while service can be given. There are so many factors involved and so little definite data available that it would require an extensive program of collecting and compiling data before a serious study of the problem could be made."

A Freak Blanket

A "MAGNETIC BLANKET" is blamed for poor radio reception during the past winter. At times the "blanket" seemed to lift and let the Hertzian waves travel longer distances; but in general, it suffocated the waves. The winter of 1925-26 will go down in history as one of the worst seasons of radio reception.

Cage Aerial Improves WOR

STATION WOR is now using a six-wire cage aerial instead of an eight-wire flat top aerial, with the result that the radiation has increased from 6½ amperes to 9½ amperes. The lead-in is also built in the form of a cage. The aerial proper is insulated by two two-foot glass insulators.

Seventeen Stations in WEAF'S Network

GRADUALLY WEAF's radio network is expanding; and it now totals sixteen broadcasters connected with the New York microphone by land wires. These allied transmitters are WEAF, New York; WEEI, Boston; WTAG, Worcester; WJAR, Providence; WFI, Philadelphia; WOO, Philadelphia; WCAE, Pittsburgh, WCAP, Washington; WGR, Buffalo; WWJ, Detroit; WSAI, Cincinnati; KSD, St. Louis; WLIB, Elgin; WGN, Chicago; WCCO, Minneapolis; WEAR, Cleveland; WOC, Davenport. The stations at Elgin, Illinois, and WGN, Chicago, alternate in taking the programs from New York; and the same is true in the case of the two Philadelphia stations. There are eighteen transmitters in the chain, but the alternate broadcasting makes the maximum tie-up sixteen. It is probable that more stations will be added in the future.

Radio Pianos Tuned Regularly

THERE are numerous aspects of broadcasting which rarely come to the attention of broadcast listeners, but which are important factors in the enjoyment and reception of the programs. The four pianos of WEAF are tuned regularly on Saturday, their tone is regulated once a month and constant vigilance exercised as to pitch. After a year's service they are returned to the factory for a thorough overhauling. The pianos at this Broadway station are used on an average of thirty hours a week.

Hotel Marseilles
BROADWAY AT 103d STREET
(Subway Express Station at Door)
NEW YORK CITY

Absolutely Fireproof

Near Riverside Drive, Central Park, Theatres and Shopping Sections

Single room, running water . $2.50
Single room and bath $3.00
Double room, bath $5.00
Handsome suites of 2 and 3 rooms

Dinner de Luxe $1.35
Served in Blue Room and Grill
Exceptional Orchestra

M. P. MURTHA, Manager

WHY NOT spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies.
MR. SINCLAIR, DEALER IN INSECTS.
Dept. 36, Box 1424, San Diego, Cal.

TYPEWRITER PRICES CUT
World's best makes—Underwood, Remington, Oliver—prices smashed to almost half.
$2 and it's yours
All late models, completely rebuilt and refinished brand new. GUARANTEED for ten YEARS. Send no money—big FREE catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10-day free trial offer. *Limited time, so write today.*
International Typewriter Ex., 186 W. Lake St. Dept. 560 Chicago

Experimental and Model Work
Fine Instruments and Fine Machinery, Inventions Developed.
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

GEARS
All Kinds-Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

TELESCOPES
SEND FOR CATALOG
W. & D. MOGEY
PLAINFIELD, N.J.

BECOME A FOOT CORRECTIONIST
$3,000 to $10,000 yearly in a business of your own.—many are making it in the New Profession of foot correction, not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.
STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

FOR MEN OF BRAINS
Cortez CIGARS
—MADE AT KEY WEST—

CHEMISTS
OUR NEW CATALOG OF
Laboratory Apparatus and Chemicals
(1000 illustrations) containing a complete line, is now ready for distribution. Sent without charge to Firms, Chemists, Schools, Hospitals, Druggists, etc., requesting it on their business letterhead. Others should remit 25c, which will be refunded on first order for $5.00 or more.
LABORATORY MATERIALS COMPANY
637 East 71st Street Chicago, U. S. A.

AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

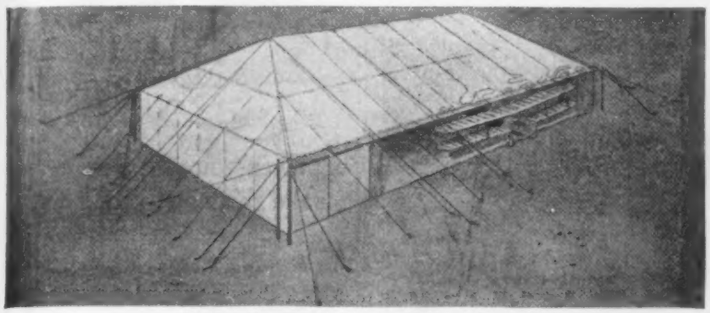
$12.50
U. S. Army Model 1917 Rifle
Cal. 30, five shot. Barrel 25 1-4 in., total length 46 in., weight 9 1-2 lbs. Barrel new. Sight mounted over receiver. This type used by A.E.F. **Price $12.50.** Ball cartridges $3.50 per 100. Gunners cleaning kit 85 cents. **Tents,** cots, **Hammocks,** canteens, **Knapsacks,** haversacks, **Outing Suits,** hats, helmets, **Saddles,** bridles, **Bugles,** lariats, **Medals,** etc. **15 Acres Army Goods. Catalog 1925, 60th Anniversary** issue, 372 pages, fully illustrated, contains pictures and historical information of all American military guns and pistols (incl. Colts) since 1775, with all World War rifles Mailed 50c. Est. 1865. **Spec. New Circular** for 2c stamp.
Francis Bannerman Sons, 501 Broadway, New York City

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics



A huge portable hangar for airplanes

A Portable Hangar

A PERMANENT airplane hangar may cost anywhere from $15,000 to $40,000. This constitutes an important initial outlay for an air transport company, particularly in the experimental stages of its existence. It has therefore been frequently suggested that cheap portable hangars might be useful under such circumstances.

An interesting type of portable hangar has now been designed by the Spalding Construction Company. The hangar has a center ridge to form a well-pitched roof. There are sixty-foot wide doors with cables to support the door curtains. The ridge is carried on poles far enough apart for planes inside the hangar to pass between them. A double set of guys is used, one independent of the canvas and the other attached to it.

With care such a canvas hangar could ride out a 100-mile-an-hour wind. The canvas hangar can be safely heated with oil stoves and ample daylight is admitted through the walls. It is curious to what size and engineering form the simple canvas tent has grown!

Altitude Flying

LIEUTENANT MACREADY is trying hard to regain the world's altitude record, which the Army Air Service lost to the French aviation service. The altitude record has more than a sporting significance. To win in aerial combat, the safest principle is to get "on top" of the enemy and to dive rapidly on him in attack. The aviator whose plane has the greater "ceiling" is therefore likely to win.

In altitude flight, many technical problems are involved; the securing of large lift in the wing, and the employment of the supercharger to maintain the power of the motor at great heights among many others.

But perhaps the most fascinating part of the altitude climb is the effect on the pilot. He must combat cold, lack of oxygen and lack of air pressure. On February 22, 1924, when Macready flew to 35,000 feet, a tem-

Wide World

This illustration shows a special Army Air Service plane in which Lieutenant John A. Macready reached a height of 37,579 feet. The world's record is 39,586 feet. At the side of the engine is shown a new gear-driven super-charger. At high altitudes, the air has so low a density that the power of the motor falls off very quickly. The super-charger compresses the rare air before it is delivered to the motor. It was a mechanical failure in this super-charger that prevented Macready from reaching his goal which was 40,000 feet. Certain other features are embodied in the design of a plane for high altitudes. A heavily cambered or thick wing is employed, giving a great deal of lift. For the same reason the wings are set far apart, giving the machine a somewhat topheavy appearance. The wings are also given a large ratio of length to chord or width, which also helps in the climb. A deep fuselage is employed in which the pilot sits well sheltered from the wind

SIMONDS

CIRCULAR SAWS
PLANER KNIVES

GOOD TOOLS STOP WASTE

Continuous production is dependent upon good tools —tools that last—tools that do not lose their cutting edges in hard service. The name Simonds on cutting tools is a guarantee of dependability—of quality born of a near century's experience in making cutting tools of specially treated steel. Next time—specify Simonds.

SIMONDS SAW AND STEEL COMPANY
"The Saw Makers" Established 1832
FITCHBURG, MASS.
Branch Stores and Service Shops in Principal Cities

Home Magic

WITH all America's genius for saving time and labor, little was done for women until the Universal electric motor was developed.

What a difference now! Connect a wire to any light socket or plug and housekeeping becomes a pastime. The magic of motor driven vacuum cleaners, floor polishers, dish washing machines, ice making refrigerators, oil burning furnaces, etc., lightens the housewife's load and gives her leisure to enjoy the better things of life.

Having been one of the first manufacturers of Universal motors, this company has contributed greatly to this service. From the beginning DUMORE Motors have been constantly improved to meet these many requirements.

For any use requiring ¼ of a horsepower or less, at speeds up to 15,000 R. P. M. specify a DUMORE Motor.

WISCONSIN ELECTRIC COMPANY
48 Sixteenth St., Racine, Wis.

DUMORE

Fractional Horse Power Motors

A GOOD IRON FENCE

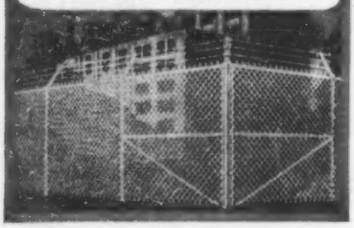
affords permanent protection, improves plant appearances, is a perpetual guard against prowlers. That's the reason so many leading industrial plants have erected

Stewarts IRON FENCE
STANDARD OF THE WORLD

DIGNIFIED—ENDURING—ATTRACTIVE
—it instills pride among workmen. We offer you a wide choice in designs and a product recognized as "standard." Send for catalog.

Chainlink Factory Fence
with fabric *galvanized after weaving* and as long lived as our heavy fence framework. Let us quote on your requirements.

THE STEWART IRON WORKS COMPANY
(Incorporated)
341 Stewart Block, Cincinnati, O.
"The World's Greatest Iron Fence Builders"



The Best Ideas

From

150 Business Magazines

The really worth while ideas—whether on selling, or management, or finance—can best be obtained from worth while business magazines. But can you afford to read through hundreds of magazines each month to get the really worth while ideas out of all of them?

LEFAX 150 Business Magazines in One

Contains the best ideas published in 150 business magazines digested and condensed into one compact magazine with articles methodically arranged so that they can be removed and inserted **in your pocket memorandum book, or filed for reference.**

Each month our editorial staff goes through the list of business magazines, picks out the most useful articles in each field, strips them of all unessential details, and presents the concentrated, business-building facts to its readers. Whatever your business may be, each issue of LEFAX contains something that will interest and assist you.

PIN THIS AD to your card or letterhead

We will place your name on our subscription list ($3.00 per year) but if you are not satisfied with the first copy you may cancel your subscription and will owe us nothing.

LEFAX, Inc., 145 S. 9th St., Phila., Pa.

Courtesy of Society of Automotive Engineers

The metal-clad MC-2 as it will appear in the air. The short, stubby form has proved more efficient aerodynamically than the conventional elongated airship forms

perature of 83 degrees below zero, Fahrenheit, was recorded.

To date the element of cold is most easily combated. Heavy underwear, a leather flying suit, thickly padded with down and feathers, headgear lined with fur, and goggles, coated with anti-freezing gelatin, provide ample protection, in conjunction with air heated by the motor exhaust.

Lack of oxygen and lack of pressure are much more difficult to withstand. Most pilots must begin taking oxygen around 16,000 or 17,000 feet, using more and more as they ascend. At extreme altitudes, say 30,000 feet, the difficulties are even greater. It seems to make no difference how much oxygen the pilot consumes, because at the low pressure of one-fifth of normal atmospheric conditions, he seems unable to assimilate either air or oxygen in the great volumes required to compensate for the low pressure and density. This is where the pilot must watch himself. The least movement of his arms or any part of his person causes a need for more oxygen, and induces light-headedness. Absolute immobility becomes imperative. The pilot must even be relieved of the slight movements required in recording data and all instruments must be self-recording in such adventurous flights.

A Metal-clad Airship

THE rigid airship as constructed today has an outer covering of rubberized cotton, and inner gas bags of gold-beaters skin. There is no doubt that the use of fabric has many drawbacks. It is not fireproof, it is not weatherproof, it is not durable, and while the gold-beaters skin is an excellent material in preventing leakage of gas, it is expensive and difficult to handle. Accordingly several years ago an organization was formed under the auspices of many prominent automotive men to develop a metal-clad airship which should be free from these defects.

Automatic riveting machine in operation

In an interesting paper before the Society of Automotive Engineers, Ralph H. Upson summarizes the results of many years patient and intelligent experimentation in this direction, which have been embodied mainly in

In the Red Lake gold Rush at Hudson on the northern transcontinental line of the Canadian National Railways the primitive and modern transportation facilities meet. It is 150 miles from Hudson to Red Lake and takes from 6 to 12 days by dog team. Airplanes make it in less than two hours

When you visit Detroit make this hotel your home

Here at the Fort Shelby you'll *feel* at home—for hospitality is a distinguishing feature of this hotel. Excellent equipment, friendly service and congenial environment make the Fort Shelby prominent in pleasant recollections of many thousands who visit Detroit. Yet charges are moderate. This is the *one* Detroit hotel with Servidor Service, protecting your privacy and purse.

Rates per day, $2.50 and up; a pleasant room with private bath, $3.50. Fort Shelby Garage, near the hotel, provides unexcelled accommodations.

HOTEL FORT SHELBY
Lafayette Blvd. at First St.
DETROIT

A quiet location, yet close to the busiest downtown corner

Seth E. Frymire, *Manager* — W. G. McKay, *Ass't. Sec'y.*

INVENTORS
Ideas Developed and Perfected
Models, Experimental work; labor-saving machinery for manufacturers. 20 years' experience.
Bernard & Heller, 275 Water St., New York City

GENUINE NICHROME WIRE
Easy Now to Make and Repair Electrical Appliances
Highest grade resistance wire needed in all electrical appliance building and repair; Absolutely guaranteed up to 660 watts, 110-12-Volts, 6 Amps. Put up in handy packs, enough to wire or repair range, furnace, iron, griddle, toaster or any appliance, complete with mica washers and full instructions. Or furnished in straight lengths 100 ft. or more; small size round or flat 1 1-2c foot; Large size round 2c foot. Order today. Either enclose money, stamps or draft.
COMPLETE PACKAGE 60c
ANDERSON-PITT CORP.
Makers of the Anderson-Pitt Heater
2609 WALNUT STREET KANSAS CITY, MO.

PATENT FOR SALE
RIM CONTRACTOR and EXPANDER for facilitating the changing of tires on automobiles. United States Patent No. 1,623,256. Address
J. L. GREENWOOD, North East Harbor, Nova Scotia

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

WOOLWORTH BLDG. - 233 Broadway, N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

Pacific & Atlantic

An Army Air Service training plane in which snow skids have been substituted for the customary wheels

the design (but not yet the construction) of a 200,000 cubic feet airship, the *MC-2*.

The hull of the proposed airship is to be entirely of metal except for an internal fabric diaphragm which provides the ballonet or air-control chamber always found on the more conventional types of non-rigid and semi-rigid airships. The design of the hull offered some exceedingly difficult problems in mechanical construction. The art of rolling a very long and wide duralumin sheet of only 8/1000 of an inch in thickness was painfully developed. Then arose the question of making the joints in the thin metal gas tight. This was accomplished by an intensive study of the homely gasometer. Spacing of rivets and other dimensions at the joint were tried which were the reproduction of a gasometer on a small scale. With the aid of a special seam dope, surprising results in gas-tightness were achieved; the gas leakage was only one-tenth of that of gold-beaters skin, which had so far surpassed all other material in permeability.

There still remained the problem of dealing with the immense number of tiny rivets required. In the comparatively small *MC-2*, 3,000,000 small rivets would be required. The difficulty was finally solved by the design of an automatic riveting machine which drives 5,000 rivets an hour, takes care of its own spacing and does the work infinitely better than it could be done by hand.

Fatigue and vibration tests on both the covering and the joints proved satisfactory.

Would the metal covering, granted that tightness and riveting problems were solved, prove so heavy as to be impractical? The metal sheet, while less than one-third as thick as the fabric, was four times as heavy per square foot. Nevertheless, the most careful calculations applied to an airship of the size of the *Shenandoah* showed that the metal-clad airship would have a far lighter structure than the rigidly trussed, fabric-covered dirigible of the conventional type!

Considered as a cover, the metal sheeting serves the same purpose as the conventional, fabric outer cover, but by eliminating the flapping and moisture absorption so common to fabric, it does it more efficiently. That is not the whole advantage however. In the metal-clad airship, the surface cover or plating also holds the gas (thus eliminating the usual gas cells) and in combination with frame members, it actually takes a large share of the stress, which the rubber fabric does not. Hence the saving in weight.

The general principle of construction of the metal-clad may be said to be similar to that of a steamship, in which the frame and plating are neither of them structurally self-sufficient, but support and reinforce one another.

An important development which arose in the experimental work, although not peculiar

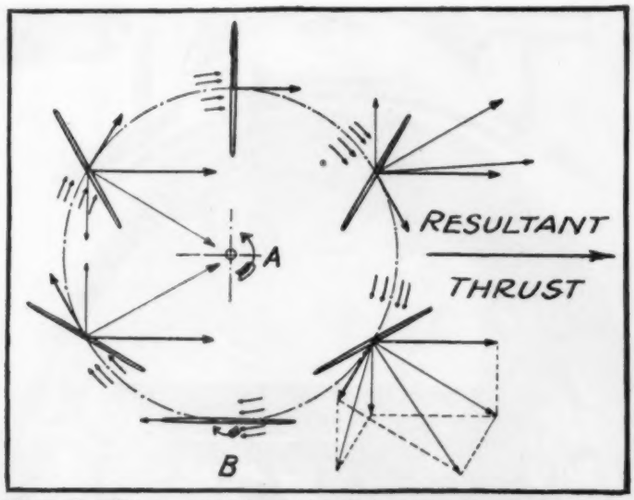


Figure 1: Diagram of action of the blades of the Kirsten-Boeing propeller. The resultant thrust for the disposition of the blades shown is horizontal and from left to right. By a simple mechanical movement the blades can have their relation to the circular path altered, so that the resultant thrust can be made to act in any direction

Action!

Whatever he wears, from the ground up, has to play the game, *man-fashion.* ¶That's why you see so many Florsheim Brogues on every university campus. ¶This one, for instance is *The Frat.*

The Collegian

Most Styles $10

THE FLORSHEIM SHOE CO.
Manufacturers
CHICAGO

The Florsheim SHOE

Style M-202

The FLORSHEIM SHOE

Spyglass on Remote Machines

THE DIAL of this *Veeder* Magnetic Counter is your spyglass on machines out-of-sight. Placed over your desk, it gives you a view of machine operations as they *count* in recorded production. Your eye is always on the job that's *"on the wire"* with this

Veeder COUNTER

The "Form UM" Magnetic Counter below counts machine operations or units of output, electrically communicated.

Cut ½ Size

REMOTE INDICATING

Mechanical contacts on your machine make and break the electrical circuit which operates the counter. The electro-magnetic drive can get its current from your regular lighting circuit: Direct current, 110 Volts.

For machines, devices or apparatus where you can't put on a mechanically operated counter, you readily attach a contact-maker and get your count "over the wires."

"Form UM" and larger Magnetic Counters are fully described in a special bulletin. Write for copy—with the full-line Counter Catalogue.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

Dangerous Reading

Beatrix as she is conceived by the English artist, Hugh Thomson.

ANATOLE FRANCE was a writer unsurpassed in modern times. He says the beginning of education is being interested. You can't learn when you are bored. Hasn't your own experience taught you that?

How many people hate works of genius today because they were forced down their throats at a time when they found them dull? How many really great books and plays have been eternally spoiled for you because you were bored by them and had to read them at school, or from a sense of duty?

The truth is, whether a story was written last week or a hundred years ago—whether it is by a "classic" author or a widely-heralded best seller—*if it is dull* it is dangerous reading for the man or woman who has discovered what education means.

When you have laughed, wept or thrilled over one short story that is really good; when you have been absorbed in one truly moving book; when you have sensed life a little more keenly because of the winged words of one vivid poem, you have contributed more to your education than a man has received from scores of impressive volumes read from a sense of duty.

That is why

The Golden Book

makes such an appeal to the reader who demands something interesting and at the same time enduring. From the vast storehouse of the world's classics, written perhaps this year, perhaps thousands of years ago, each month it offers you those great stories, poems, plays and adventures that remain great because they are alive today.

As the telephone, the automobile and the radio enable you to live more richly, this new and delightful magazine has been inspired by the modern spirit to give you the pure gold that genius has mined. From all countries and all times it brings you adventures into literature.

The charm of The Golden Book is like the charm of an exquisite bouquet, of a delightful meal—just the right selections relative to you and to each other. It is that indefinable thing—the personality of The Golden Book—that has brought in one year 200,000 devoted readers. It is really edited.

How Would You Enjoy *a Lunch with Beatrix Esmond?*

Beautiful Beatrix, immortal in fascination, irresistible in mysterious feminine appeal—with a touch of the devil. If she came to your town, would you invite her to lunch, if you had the chance?

Of course you would, and that luncheon would be history in your life, for Beatrix, Thackeray's heroine, is one of the most tantalizing women ever created.

Beatrix is not alone. There are dozens of these exciting women waiting for you.

You feel their presence in the room with you—electric, intoxicating. As if by magic they step out of the pages that hold them, to you. They are as alive as the girl you noticed on the street today. Hundreds of men have fallen in love with them.

You don't seek out the commonplace girl in real life. If women interest and delight you, don't be content with pale, dull heroines who are only imitations of the colorful great ones.

That is the endless pleasure of The Golden Book. There you are always sure of meeting the most wonderful women who ever sent a man's heart pounding. From all countries and all times are the women it would thrill you most to know. Meet them in The Golden Book.

Among the contributors to the April Issue are:

W. Somerset Maugham	James Stephens
Georges Clemenceau	O. Henry
Stewart Edward White	Lafcadio Hearn
Joseph C. Lincoln	Baudelaire
Stacy Aumonier	Lewis Carroll
Robert L. Stevenson	Thomas Hardy

Special Offer for Readers with 20th Century Minds

Everyone who loves books that are interesting will see at once the dazzling possibilities of such a magazine. In order that you may know yourself how stimulating The Golden Book can be, we have decided—*for a little while only*—to make a special offer to new subscribers. The regular price of The Golden Book is twenty-five cents a copy. We are going to send you two issues at our expense, and this is how. If you act at once we will give you The Golden Book for six months for $1.00 instead of $1.50. But—this is only for prompt action. Simply fill out the attached coupon and mail it to us today. Do it now, while you are looking at it. This is only a temporary introductory offer to new subscribers. We cannot offer it long. We do not promise ever to make it again. Sooner or later you are going to become enthusiastic about The Golden Book if you enjoy reading fascinating stories. Send the coupon at once and be glad. Do not wait and be sorry.

Only One Prompt Dollar

Introductory Offer 6 Months for $1

THE GOLDEN BOOK MAGAZINE
55 Fifth Ave., New York
Send The Golden Book to the address below at Special Introductory offer, six months. I enclose $1—instead of the usual $1.50.

Name .....
Street .....
City .....

to metal-clad construction, is worthy of note. It was found that a short stubby form, as shown in our illustration, with a ratio of length to diameter of only 3.4 to 1, was aerodynamically more efficient than the elongated shapes hitherto employed, and that the control and stability were also far better.

Space does not permit us to describe many other interesting features of the design, nor is it possible to say definitely whether the idea will prove successful in practical operation. Nevertheless, it would seem that much has been achieved by these original and painstaking engineers.

A Swivelling Propeller

IT has long been recognized that an airship would gain greatly in maneuverability if the thrust could be made to vary in direction.

The Kirsten-Boeing propeller, invented by an American, but described fully for the first time in *Zeitschrift für Flugetchnik*, seems to have achieved a versatility of thrust direction which is remarkable.

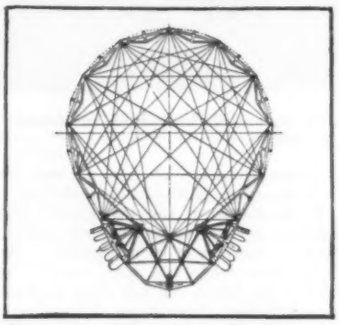


Figure 2: The Kirsten-Boeing propeller as applied to an airship of the Los Angeles type. Normally the propellers give a forward thrust, but they can be made to give up or down forces, a great advantage in airship control

The principle of the propeller is illustrated in the diagram of Figure 1. The six blades of the propeller rotate about its main axis in the direction shown by the curved arrow, A. At the same time each blade rotates about an axis at its center in the direction shown by the curved arrow, B. The rotation of B is half that of A, so that the blades turn only through 180 degrees while the whole propeller turns through 360 degrees. In the particular disposition of the blades shown in Figure 1, the resultant thrust of all the blades is horizontal and from left to right. If by a simple mechanical device the relative position of the blades is changed so that a blade is horizontal, for instance, when in the topmost position, then the resultant thrust becomes vertical.

Unfortunately, an exact description of all the mechanical features of the device is not available, but Figure 2 will give our readers a fair idea of the application of the Kirsten-Boeing propeller to an airship. Only the blades of the propeller project outside the airship; the driving mechanism and the mechanism for altering the position of the blades are all within the hull. Normally, the propellers on both sides exercise a forward thrust. But they can also be made to act up or down or even backwards. If two propellers are placed at the stern of the airship they can be made to act as rudders, or elevators.

The advantages of the propeller in the handling of the airship are obvious. Control is maintained even when the airship is at rest, whereas with the ordinary rudder a turning movement is obtainable only when the airship is under way. Vertical control is also enormously increased. For example, if an airship in the course of a long journey is becoming light owing to consumption of fuel, the propellers can be made to give a downward thrust, thus eliminating the necessity of valving gas or for the employment of ballast-recovery methods.

The Kirsten-Boeing propeller has been tried experimentally in the model basin and on a fast motorboat (it is applicable to either air or water vessels) with entire success, and its further progress will be worthy of interest.

Snow Skids

FITTING snow skids to an airplane is much more of an engineering problem than would be apparent at first.

The skid must be free to rock about the axle (which travels upwards against the resistance of rubber shock absorbers) but must not rock too much; hence the provision of long rubber strands at the rear and front of the skid. The skid must be as small and light as possible, yet provide sufficient area for the bearing pressure on the snow to be moderate, and have just the right curve to its surface in front to enable the plane to make a quick get-away or a landing without plowing over.

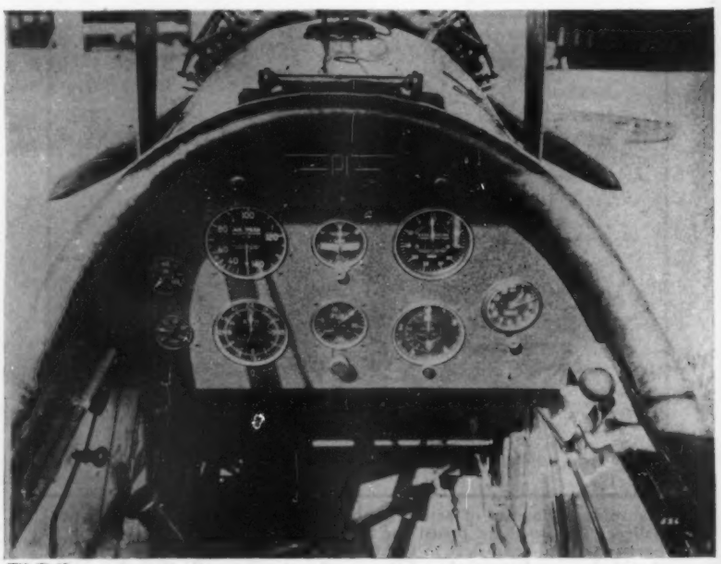
A typical and entirely satisfactory construction is shown in our illustration.

A Modern Instrument Board

OUR illustration shows a typical, modern dashboard for a cross-country flight. Pioneer aviators used to rely almost entirely on their senses to gage both the equilibrium and the maneuvers of their planes. Modern pilots use every instrument that science can provide. In this particular dashboard, designed by Morris M. Titterington, every requirement of scientific flying is provided for.

In the top row, left to right are: the oil-

(*Continued on page 356*)



Wide World

A well arranged dashboard in the modern airplane

SCIENTIFIC AMERICAN

The Magazine of Today and Tomorrow

"Everyone, I think," says H. G. Wells, "should read such a weekly newspaper as Nature, of London, or the Scientific American to keep in touch with the ever-advancing boundaries of human knowledge and achievement."

When the distinguished writer, universally recognized as one of the keenest analysts of modern times, says everybody, he means it literally—the scientist and the college graduate equally with the man whose schooling was cut short in childhood.

"A day will come," he declares, "when people will realize that they have no more right to give up reading and serious study because school and college days are over than they have to give up washing or the use of a toothbrush because they have grown up out of the tutelage of home."

Too many of us are casual about our reading. If we happen to see the Scientific American on the news stands we buy it; if it fails to catch our eye we let it pass. Indeed, many a man relying upon the chance of buying the magazine on the way to his office or his home, finds that all the copies have been sold. And the number he misses may be the very number in which appears an article of especial importance to him.

Right now things are happening you will want to know about. Next month and the month after developments of tremendous importance to science, to industry, to your own well-being are being reported in the Scientific American. You will not want to be unacquainted with them. Every month you miss reading the Scientific American is a month lost—lost pleasure, lost education, lost opportunity. Each month you read it is a month gained—gain in knowledge, in enjoyment, in power.

To get the fullest possible benefit from the Scientific American read it regularly, consistently, every month. There is but one best way to insure this—subscribe. At $4 a year how can you afford not to?

SCIENTIFIC AMERICAN
Woolworth Building
New York, N. Y.

Send Scientific American to me as checked below.

☐ One year for $4.00

☐ Three months for $1.00

I will send my check when I receive your bill.

Name.....

Street or Box No.....

P. O..... State.....

Postage extra for foreign subscriptions

DO YOU KNOW

HOW the big business men of today reached their high positions?

WHAT the leaders in this nation are thinking and planning?

❖ ❖ ❖

HOW to meet the servant problem in your home?

HOW to find greater success, better pay, more pleasant work?

❖ ❖ ❖

WHERE workers and employers have succeeded in solving their problems?

WHEN your food is likely to shorten—rather than lengthen—your life?

❖ ❖ ❖

WHO wrote "Advice to the lovelorn" and what is she like?

WHO built a $10,000 home with $27 capital?

❖ ❖ ❖ ❖

You will find a wealth of entertainment, inspiration and practical help ready for you in every number of

SUCCESS

Notice the SAVINGS shown on the COUPON! Sign and send it TODAY!

Success, 251 Fourth Ave., New York, N. Y.

Please enter my subscription as checked below.

☐ TWO WHOLE YEARS for $4.00.
(Saving $2.00 on the single copy price.)

☐ One year for $2.50 (saving me 50c.)

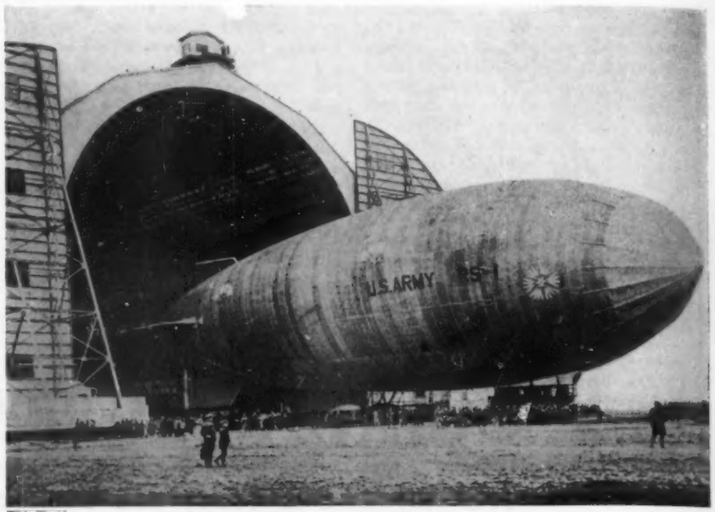
I will send my check on receipt of your bill. (By enclosing your remittance now, you can avoid all further bother.)

My Name is.....

Street.....

City..... *State*.....

68



Wide World

The Army Air Service RS-1 being slowly hauled out of its hangar. It is one of the largest semi-rigid airships in the world

pressure gage, which indicates whether the motor is receiving the correct amount of lubrication; the air-speed indicator, which shows the speed of the plane relative to the air, and not only gives an indication of the distance flown (not entirely correctly, since it does not allow for the speed of the wind) but also warns the aviator in case his speed falls too low for normal flight; the bank-and-turn indicator, which tells the pilot whether he is flying on an even keel and in a straight line, and is particularly important in fog flying when there is no horizon or landmark to refer to; and last in the top row is the climb indicator, an extremely sensitive instrument which is most important in climbing tests of the airplane.

In the bottom row, left to right are: the radiator thermometer, which warns the pilot in case his motor is overheating; the tachometer, which tells him whether his motor is turning up the proper amount of revolutions; the fuel-level gage, which warns him when his gas is running low; and the altimeter, which tells him the height of the plane. The electric clock and the control switch complete the equipment.

A Huge Semi-rigid

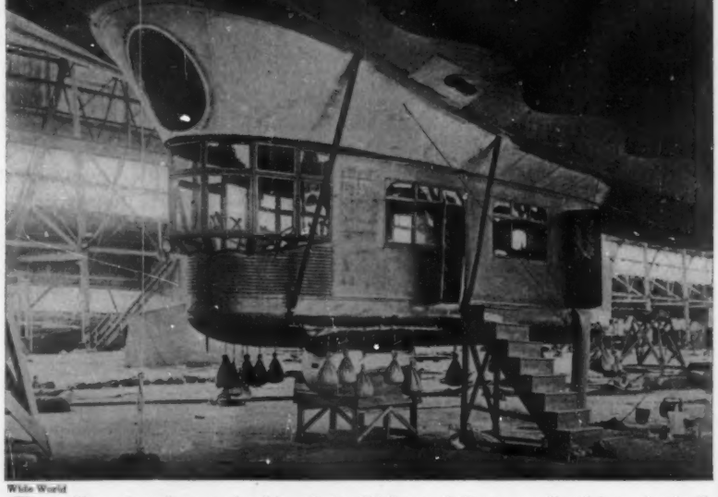
AIRSHIPS may be broadly divided into three classes: rigid, semi-rigid and non-rigid. In the rigid airship, reliance is placed solely on the metal framework for the maintenance of the correct outer form; in the non-rigid, excess internal pressure of the gas puts tension in the fabric and counteracts any tendency to deformation due to the loads carried; in the semi-rigid, gas pressure is combined with a truss or keel running the whole under length of the airship.

From the point of view of useful load, the rigid is inferior to both the other types; in the non-rigid it is difficult to maintain form except for comparatively small airships. By many designers the semi-rigid is regarded as a happy compromise, not so heavy in its structure as the rigid of the *Los Angeles* type, yet withstanding deformations successfully in quite large designs.

The United States Army *RS-1* is one of the largest semi-rigids ever built and it has proved entirely successful on its maiden flights. The *RS-1* measures 282 feet in length and has a gas capacity of 760,000 cubic feet of helium—approximately one-third that of the *Los Angeles*. It recently carried 13 passengers with 4,200 pounds of gasoline at an average speed of 40 miles an hour; fully loaded with gas it can make a sustained flight of 2,000 miles.

In one of our illustrations we show the entire length of the airship as it is being slowly hauled out of the hangar, with its control cabin forward and the engine nacelle in the rear. The other illustration shows how carefully the control cabin is streamlined into the envelope.

The control cabin of the *RS-1* is quite as complicated and well-equipped as that of the larger *Los Angeles*.



Wide World

The well equipped control cabin of the RS-1 carefully streamlined into the hull of the airship

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

Don'ts for Inventors

IF a manufacturer licenses your invention on a royalty basis and it is a success, that usually is the best arrangement for you. There have been cases, however, where a manufacturer has obtained from an inventor an exclusive contract for the manufacture and sale of the invented article, and has done so, not because he wanted to make it, but because he wanted to prevent anyone else from making or selling the article. He has guaranteed to give the inventor a certain percentage of the profits or a certain fixed sum for each article sold. As none of them were sold, the inventor's royalty amounted to nothing. The inventor had no redress. He was bound by contract.

To avoid this danger, *don't fail to see to it that any contract providing for a royalty has a minimum guarantee—that there is some provision which will insure that the article actually is to be made and sold—which will make it against the interest of the manufacturer not to sell it, or that the contract is cancelled if the minimum is not produced.*

(More don'ts will appear in this department from time to time.)

Radio Sets at Half Price

MANY merchants are like St. Paul—all things to all men. Walk into a drug store and you can buy anything from a ham sandwich to a set of razor blades; in a cigar store you can purchase tooth powder or candy. Naturally, the department stores assail this state of affairs at every opportunity.

Recently, Wanamaker's New York store printed an advertisement telling about a large quantity of Thermiodyne radio sets which were to be sold at half price. After describing the Thermiodyne national advertising campaign and how the sets had been sold through the United Cigar Stores, it went on:

"Then came the awakening—the public wants to buy their radios from radio stores, who know their business, who know the product, who, because of their knowledge, can advise purchasers what to buy, show them how to use it, install it, and stand back of it with real service. The great idea did not succeed. It was based on a wrong method of distribution."

J. W. Guibord, president of the Thermiodine Radio Corporation, however, is quoted as follows:

"Like other radio manufacturers we planned for a big year in 1925 and, like other radio manufacturers, we ran into what the trade is already aware was a year of overproduction. We made a special deal for New York City alone with the United Cigar Stores. When this plan did not produce the expected sales and inquiries, the failure, such as it was, was confined entirely to New York, and was only an incident in our campaign as a whole."

In 1925 the Thermiodyne spent $500,000 on advertising. This year they will advertise almost as heavily. Wanamaker's, following the appearance of their advertisement in the newspapers, sold Thermiodynes at the rate of 500 a day.

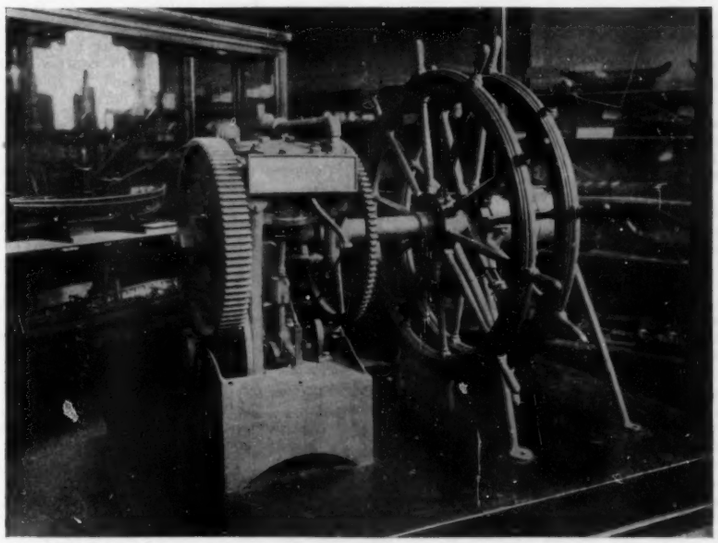
National Biscuit Triumphs

IN the March issue an item appeared in this department, under the caption "Victory for Small Grocers," telling how the Federal Trade Commission had ordered the National Biscuit Company to discontinue making price discriminations in favor of chain grocery stores and against independent grocers organized into associations.

The general counsel for the National Biscuit Company calls our attention to the fact that the Circuit Court of Appeals sitting in New York reversed and set aside the order of the Federal Trade Commission in this case, saying, "We conclude that the sales policy of the petitioners as to their discount plan, as well as the refusal to sell coöperative or pooling buyers, is fair in all respects as to all its competitors and customers."

Not only that, but the Supreme Court of the United States found no error in the decision of the Circuit Court of Appeals and refused to review the case.

We accept the amendment. Thank you, counsellor.



Development in many lines is at a standstill until some device renders it practicable. Navigation of our great ships is possible because Daniel E. Sickles invented the steam steering apparatus in 1858. This is the first one used

Taking Stock of Industry

THAT the wheels of American industry are whirling at ever-increasing speed is generally appreciated. The rate of this acceleration has now been measured and the figures are startling even to the most confirmed of optimists.

The Bureau of the Census has recently published its Census of Manufacturers for 1923. To make a proper comparison with preceding census years we must go back to 1914, the years 1919 and 1921 being abnormal, the former being characterized by unusual industrial activity and the latter by industrial depression.

In 1923 there were 196,309 industrial establishments valued at $5,000 or more. In 1914 there were 272,518. On the face of it that hardly looks like growth. But wait.

In 1923 the number of men and women at work in these industries averaged 8,778,156. In 1914 the average was 7,023,685. A gain of approximately 25 percent.

The wages paid in 1923 totaled $11,009,298,000. In 1914 they amounted to $4,067,718,000. This increase is startling, but the figures need some readjustment. A dollar in 1923 had dropped 48 percent in purchasing power from the purchasing power of a dollar in 1914. Calling the payroll of 1923, then, only $5,724,835,000 we find the wage increase is 40 percent over 1914.

Materials for the industries in 1923 cost $34,705,698,000; in 1914 they cost $14,358,935,000. Again we readjust the figures in the light of the dollar's decreased value and we fix the 1923 cost at $18,046,963,000. A gain of 25 percent.

The value of the finished products turned out by these industries was $60,555,998,000 in 1923; the value in 1914 was $24,216,515,000. Thus the values added by manufacture were $25,850,300,000 in 1923 and $9,857,580,000 in 1914. A gain of 38 percent in value created.

In 1923 the primary horsepower used was 33,094,228; in 1914 it was 22,401,401. An increase of 47 percent.

Such figures are abundant food for thought. There are fewer industrial plants but more men are employed. Obviously, the plants are bigger. The gain in numbers of workers was approximately 25 percent but their earnings increased 40 percent.

Materials cost 25 percent more in 1923 but the increase in their value exceeded the added values of 1914 by 38 percent. And this greater value increase resulted directly from the use of 47 percent more horsepower.

Consolidation of smaller plants into bigger ones, greater reliance upon machinery, less upon man power, and, as a result, greater wealth for the country and for its workers—such is the record of science in industry as set down in the figures of the Census Bureau.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

GARTER, ARMLET, OR LIKE BAND.—Adapted to be worn on an article of wearing apparel, in encircling relation, to prevent accidental displacement of the article. Patent 1569968. L. M. Davis, Fairmont, W. Va.

HAT.—Having adjustable means for permitting a variation in head sizes without changing the general appearance of a ladies' hat. Patent 1571107. Agnes Capelle and H. Harris, c/o Harris & Capelle, 64 W. 36th St., New York, N. Y.

WOODEN SHOE.—For protecting the feet of bathers against cuts, in going to and from the water, and against injury from sea life. Patent 1571498. C. J. Swanstrom, P. O. Box 43, Coronado Beach, Calif.

ORNAMENTAL BUTTON.—Which will disclose a button structure with an ornament thereon, and may be readily stitched to a garment. Patent 1572803. A. I. Lewis, 87 Gerard Place, Newark, N. J.

Chemical Processes

PROCESS FOR MAKING WATERPROOF PORTLAND CEMENT.—Which consists in thoroughly incorporating into a cementitious material a mixture of "beta naphthol" and non-volatile oil. Patent 1566498. C. N. Miller, 416 Funston Ave., San Francisco, Calif.

PROCESS FOR THE DISTILLATION OF NATURAL RESINS AND OLEORESINS.—Which comprises mixing therewith from 1 to 5 percent of tribasic phosphoric acid, and distilling the mixture at a temperature of 310 degrees centigrade. Patent 1572766. J. M. A. Chevalier, P. Bourcet, H. Regnault, c/o C. Chassevent, 11 Boulevard De Magenta, Paris, France.

Electrical Devices

METHOD FOR STARTING AN ARC IN A WELDING APPARATUS.—By the superimposing of a high voltage high frequency current of small amperage on the circuit containing the low voltage source of energy for the purpose of causing the high voltage current to jump across the gap under conditions which would not allow the low voltage current to become active. Patents 1570803 and 1570804. F. L. Walker, Jr., Box 1648, Stanford University, California.

ILLUMINATED SIGN.—In which is placed a series of electric lights to illuminate different letters or figures and make them visible. Patent 1569423. G. A. Griffin, Oakland, Calif.

THERMOELECTRIC ELEMENT.—For thermocouplers, which produces a relatively high electro-motive force when joined to a positive element. Patent 1572117. O. Hermann, c/o Thermo Electric Battery Co., 1142 Diversey Parkway, Chicago, Ill.

TELEPHONE RECEIVER.—In which the vibration of a diaphragm in response to current frequencies can be placed with a minimum amount of distortion. Patent 1573754. D. Wald, c/o United Scientific Laboratories, 80 4th Ave., New York, N. Y.

LAMP LOCK.—For lamps of the incandescent type, which operates to prevent theft, the lamp being unmovable without destruction. Patent 1573717. C. Killars, 103 Main St., Stonington, Conn.

HEATER FOR PERMANENT HAIR WAVING.—By means of which the heat may be applied either to the root portion, or uniformly to the whole hair under treatment. Patent 1573,761. A. H. Bongers, 7 The Exchange, Muswell Hill, London, N. 10, England.

Of Interest to Farmers

DRAFT EQUALIZER.—Whereby the pull exerted by a plurality of draft animals on an implement will be transmitted in a single horizontal plane. Patent 1563804. E. R. Spellman, Box 796, Walla Walla, Wash.

SUGAR CANE HARVESTER.—By which cane stalks may be severed in an efficient manner and then cut into proper lengths for the grinding machine. Patent 1570093. W. Snodgrass, Central Senada, Camaguey, Cuba.

SPOT MARKER FOR CORN PLANTERS.—By means of which corn may be planted without the necessity of using wires for guiding the planter. Patent 1570773. J. P. Oeschger and E. S. Jones, c/o J. P. Oeschger, 1244 N. La Salle St., Chicago, Ill.

Of General Interest

RECORDING SYSTEM.—For keeping a record of the steps in the manufacture of articles, that the cost of the finished article may be ascertained. Patent 1567981. C. D. Page and F. A. Behounek, c/o Page Printing Co., Grand Forks, N. D.

SAFETY MAGAZINE FOR EXPLOSIVES AND AMMUNITIONS.—Constructed to warrant safety either against atmospheric electrical discharges or the action of bombs from airplanes or batteries. Patent 1567893. F. Barattn, c/o L. Laboccetta, Via Duc Marcelli 31, Rome, Italy.

APPARATUS FOR SAND BLAST CARVING.—By which the carving of wood and like material is economically facilitated, without requiring the employment of skilled workmanship. Patent 1566711. I. B. Wellington, 4044 Monetn Ave., Los Angeles, Calif.

LIQUID WAX FOR THREADS.—For thoroughly impregnating threads used in the manufacture of leather goods and for preserving the threads against ready breakage. Patent 1567497. J. Fry, Canton, Mississippi.

BANK CHECK.—So constructed as to prevent the changing of the amount of money for which the check was originally made payable. Patent 1567613. J. Patton, Jr., 206 Brown St., Charleston, W. Va.

KEY-CHAIN REEL.—A small and light weight device, attachable to a belt from which keys may be withdrawn and will return by spring pressure. Patent 1567783. W. Best, 2139 W. North Ave., Chicago, Ill.

ICE CAN FILLER.—By which cans used in ice manufactories may be filled with just the proper amount of water, without movement after filling. Patent 1567161. V. P. Miller, c/o Miller Ice Co., Center Ave. and Main St., Chicago Heights, Ill.

TOOTHBRUSH.—In which the bristles are mounted upon a member which may be removed from the handle at will for replacement. Patent 1567507. A. A. Howard, 4057 Montgomery St., Chicago, Ill.

NOTE-BOOK CLIP.—For securing a note book from unintentional dislodgment from the pocket of the user. Patent 1567315. A. Zarembo, 805 W. Washington Blvd., Chicago, Ill.

ENVELOPE.—For registered mail, in which a return post-office receipt constitutes a detachable extension of the flap. Patent 1568880. V. A. Conklin, 513 5th Ave., Belmar, N. J.

EYESHADES.—Which may be used alone or in connection with eye glasses to shield the eyes against certain rays of the sun. Patent 1568900. H. A. Metcalf, 286 5th Ave., New York, N. Y.

RETAINER CLIP.—For use in supporting a fountain pen or lead pencil in an upright condition in a pocket. Patent 1568889. A. S. Eliasson, 150-37 21st St., Whitestone, N. Y.

GEM SETTING.—In which the gem may never be accidentally detached from a ring as long as the ring is on the finger of the wearer. Patent 1568924. A. Shatkin, 1407 40th St., Brooklyn, N. Y.

SPOUT FOR SUGAR BOWLS.—Which can be readily attached to most any kind of sugar container or readily detached for the purpose of cleaning. Patent 1568923. I. Ruiz, c/o William O. Hahn, 2649 8th Ave., New York, N. Y.

COMBINED SEAT AND DESK.—In which both can be adjusted vertically and secured in position, or packed in a small space for storage or shipment. Patent 1568211. S. W. Conwell, Grand River, Iowa.

BURGLAR ALARM.—In the form of a bell, adapted to be mounted on any window sash, to ring on the movement of either sash. Patent 1568882. A. E. Coyne, 28 Waverly Place, New York, N. Y.

CLEANING COMPOUND.—Comprising ground shelled peanuts combined with camphor, adapted for cleaning and polishing furniture, automobiles and other articles. Patent 1568910. T. S. Noguchi, c/o M. Tujimois, 536 Ft. Washington Ave., Apt. G, New York, N. Y.

RE-ENFORCED-CONCRETE WALL SECTION.—By means of which an entire section of a building, with air space between the walls, may be manufactured in one piece, durable enough to permit the manipulation of the entire section. The inventor has been granted two patents, 1568265 and 1568266. C. Carrillon, c/o J. M. Keamon, Temple University, Philadelphia, Pa.

TOOTH-PASTE EJECTOR.—Including a supporting bracket for holding a collapsible tube of paste, and means for squeezing out the required quantity of paste. Patent 1568921. T. H. and H. Roberts, Cranford, N. J.

SIPHON TUBE HOLDER.—For a flexible siphon tube, which will prevent kinks and sharp bends and prolong the life of the tube. Patent 1568931. D. E. Thomas, 2024 Saxon St., Tampa, Fla.

UNIT TRAY.—So constructed that a series of the trays may be readily locked into a vertical column to form a cabinet. Patent 1568468. E. H. Pratt, 220 So. 2nd St., Corvallis, Oregon.

ADJUSTABLE TIP FOR CANES AND THE LIKE.—The tip being resilient, and a new portion being brought into use as the old tip gradually wears. Patent 1568423. C. Sifferlen, 403 N. Ottawa St., Joliet, Ill.

WORK CABINET.—Which in closed position has the appearance of an article of furniture, but when open supplies the necessary equipments for a hair dresser. Patent 1568498. A. Caliver, Fisk University, Nashville, Tenn.

LOOSE LEAF BINDER.—In which the covers are secured to the back by a double hinge thereby assuming a flat position when opened. Patent 1568403. H. J. Holst, Apt. 24, 1377 Bannock St., Denver, Col.

CASEMENT WINDOW.—Of metal construction, wherein three or more contacts are presented, making a substantially airtight and watertight structure. Patent 1568865. S. U. Barr, c/o W. H. Jackson & Co., 335 Carroll St., Brooklyn, N. Y.

ANIMAL TRAP.—In which spring actuated means are employed to tighten a snare around the animal, the trap may be set in a small space. Patent 1567214. L. R. Van Tassel, Bear Creek Camp, Sheffield, Pa.

LAUNDRY CASE.—For boxes or fillers, which co-act with the case to present a complete grip or suit case structure. Patent 1569784. H. E. Plimpton, c/o Plimpton Mfg. Co., Norwood, Mass.

PICTURE AND OBJECT TARGET.—Adapted for use in the practice of archery, wherein the figures presented at different places on the target act as bull's eyes. Patent 1569,-781. R. P. Orr, 45 Parkwood Ave., Schenectady, N. Y.

VANITY CASE.—And mirror assemblage, in which the mirror shows through the bottom, and is available without opening the case. Patent 1569779. C. Nachemov, c/o A. J. Sossner, 361 W. Broadway, New York, N. Y.

TROUSERS CREASER.—Adapted to be inserted in the leg of the trousers and to exert tension thereon to form the creases. Patent 1569792. A. T. Smith, 4589 Lexington Ave., Los Angeles, Calif.

PENCIL ATTACHMENT.—Acting as a clip for retaining the pencil in a pocket, and greatly facilitate the work in checking and paging a ledger. Patent 1569742. J. B. Goerling, Wausau, Wis.

FISHWAY.—Adapted to be associated with a dam, for the passage of fish from the water below to the water above the dam. Patent 1569419. N. D. Chase, Hornbrook, Calif.

CARD SHUFFLER.—Adapted to receive a deck of cards and thoroughly mix them when the device is shaken. Patent 1569277. C. A. and W. J. Gunzelman, R. F. D. No. 3, Abilene, Kans.

MAKING MOVING PICTURES.—And producing composite cinematographic pictures, by the use of a plurality of mirrors, so that several personages at different points may be combined into a picture. Patent 1569789. E. Schufftan, 1938 Argyle Ave., Hollywood, Calif.

ROOF OR BUILDING TILE.—In the form of a molded plastic material, such for example as abestos,-cement, covered with a thin sheet of non-ferrous metal. Patent 1570504. L. Lane, Box 1066, Habana, Cuba.

AIR BOAT.—In the nature of a raft having a bottom, and double pneumatic chambers, and means for uniformly distributing a load. Patent 1570470. W. P. Fritsche and J. D. Clarke, c/o Clarke & Fritsche, New England Airship Co., New Haven, Conn.

ARTICLE OF FURNITURE.—Which may be transported in knockdown condition and readily assembled to form an umbrella stand. Patent 1570532. A. L. Strouse and S. Weinschenk, c/o S. Weinschenk, 9520 107th St., Richmond Hill, N. Y.

HAND BAG.—So formed that it may be readily converted from a leather bag to a cloth bag or the reverse. Patent 1570515. E. Meltzer, 64 Grand St., New York, N. Y.

MANUFACTURE OF MARGARINE AND EDIBLE FATS.—Comprising a mixture of vegetable fats and an emulsifying oil—soluble gelatinized oil. Patent 1570529. E. V. Schou, Palsgaard near Juelsminde, Denmark.

ROOF COVERING.—Comprising a plurality of roofing units arranged in courses with adjacent shingles, and locked to the roof sheeting and held against curling. Patent 1570152. J. E. Hooker, c/o H. & W. Realty Co., Ludlow and Southworth Bldg., Coral Gables, Fla.

CLOSURE FOR PIPES, VALVES AND OTHER VESSELS.—The threads employed being insulated by a double metallic seal from gases, fluids or vapors, within the pipe or article sealed. Patent 1569875. H. C. Nixon, 749 Ave. H, So. Saskatoon, Saskatchewan, Can.

UMBRELLA RACK AND SMOKING STAND.—Having hinged members by means of which the device may be adjusted to act as a table, smoking stand, or umbrella rack. Patent 1570540. S. Weinschenk, 9520 107th St., Richmond Hill, N. Y.

PROCESS OF GLAZING BRICK.—By applying glazing material, and fusing the same by passing an electric current through the brick and glazing material. Patent 1570137. A. Fischer, Jr., 4502 N. Sacramento Ave., Chicago, Ill.

SHACKLE-BOLT OILING DEVICE.—In which the lubrication may be instantly effected and means provided for storing up the oil. Patent 1570367. C. F. Wolf, 2528 N. Drake Ave., Chicago, Ill.

PROCESS OF PRODUCING ARTIFICIAL SNOW.—By passing an air blast through a previously prepared mass of hardened foam, produced with powdered casein, rennet and soluble calcium salt. Patent 1569396. J. A. Rice, 805 Santa Barbara Rd., Berkeley, Calif.

FOLDING FURNITURE.—In which the supporting means is capable of collapsing to a minimum whereby the furniture may be compactly stored. Patent 1570863. F. Simmons, 274 52nd St., Brooklyn, N. Y.

Hardware and Tools

TOOL FOR REMOVING FROM OR APPLYING DIFFERENTIAL GEARS TO THEIR AXLES.—The device is capable of adjustment to operate in vertical or horizontal position, and facilitates the application of the gears. Patent 1567892. W. C. Bakels, Midland Park, N. J.

GARDEN IMPLEMENT.—Adapted to be used as a cultivator, and having means for carrying a plurality of blades for engaging the ground. Patent 1568136. W. A. Crump, Humble, Texas.

WRENCH.—Which affords facilities for turning nuts or like parts of a plurality of different sizes within a considerable range. Patent 1569117. E. R. Carpenter, Ansonville, N. C.

STOPCOCK.—Having novel packing means for preventing escape of fluid, and means for keeping the moving parts well lubricated. Patent 1569252. J. A. Barnes, Box 631, Burkburnett, Texas.

LAWN-DRESSING IMPLEMENT.—For effecting a uniform distribution of top dressing upon the grass, and working the dressing downwardly toward the roots. Patent 1569,-421. M. T. Coelho, Box 89, Redwood City, Calif.

AUTOMATIC LATCH.—Disposed within the casing, but having a projecting handle whereby the latch may be operated from either side of the door. Patent 1570135. G. C. Emmert, Box 285, Mount Morris, Ill.

PIPE CONNECTION.—Which may be used with pipes having roughly or smoothly cut ends, so as to positively prevent leakage. Patent 1570155. V. Karbowski, 1227 Milwaukee Ave., Chicago, Ill.

GRINDING TOOL.—Adapted for cleaning electrical contacts carried by the shell of a timer, of the character employed in connection with ignition systems. Patent 1570166. A. Morris, Sabina, Ohio.

METHOD OF MANUFACTURING HORSESHOE CALKS.—From a high carbon steel wire section by a cold process during which the wire is subjected to impact and pressure. Patent 1570455. T. F. Boylan, Sr., c/o Eversharp Mfg. Co., 330 Townsend St., New Brunswick, N. J.

PIPE WRENCH.—Simple and durable in construction, reliable and effective in operation, and adapted for economical manufacture. Patent 1570627. E. J. Evans and W. H. Barber, 147 Regent St., Salt Lake City, Utah.

DRILL BIT.—Having its cutting edge so disposed near the periphery of the bit, that it will be most effective for cutting hard rock. Patent 1571348. C. O. Stee, Quartzburg, Ida.

EXTENSION BIT.—Having fastening means adjustable to bits of different sizes, the bits being quickly secured and firmly held. Patent 1571497. G. W. Staley, 3960A 18th St., San Francisco, Calif.

PADLOCK.—In which means is provided for positively precluding movement of the shackle without first removing the key actuated locking core. Patent 1572122. J. Pietrie, 2219 Iowa St., Chicago, Ill.

SAFETY RAZOR.—In which the cutting edge may be disposed at the desired angle, and the blade removed in a single operation. Patent 1572572. J. Straka, c/o W. R. Piper, 417 1st Nat'l Bank Bldg., Oakland, Cal.

GUTTER HANGER.—Adapted to have portions not only for embracing the gutter bottom exterior, but also for straddling the top. Patent 1572745. C. Meunier, Grent Neck, N. Y.

SELF-LOCKING DOOR BOLT.—For swing doors, adapted to be automatically released and moved to locking position by the closing of the door. Patent 1573653. J. H. Stewart, 714 Clifton Ave., Newark, N. J.

Heating and Lighting

HOT AIR REGULATING DEVICE.—Adapted for use in pipes leading from hot air furnaces, for controlling the hot air flow and conserving the heat. Patent 1570290. A. Unger, 7744 S. May St., Chicago, Ill.

TIME CONTROLLED REGULATOR FOR HEATING SYSTEMS.—By means of which additional weights may be engaged with a standard type weigh actuated temperature regulator, and varied at will. Patent 1570,-082. H. W. Royce, 7543 Chapple Ave., Chicago, Ill.

HEATER.—Provided with a special form of baffle or draft regulator associated with the flue. Patent 1571079. E. Witman, Sinking Spring, Pa.

DEVICE FOR ILLUMINATING OIL GAGES.—Having means for preventing the unintentional removal of a combined guard and reflecting element from the gage. Patent 1570179. M. D. Prouty, R. Craig, C. Rawlings and H. Carlson, c/o Electric Light Oil Gage Co., Galva, Iowa.

GAS BURNER.—For cooking stoves, for use in a top opening or oven bottom, with the result that practically all the heat may be used. Patent 1571822. E. E. Wann, 1717 7th St. N.W., Washington, D. C.

Machines and Mechanical Devices

AUTOMATIC SHEAVE.—Especially designed for organization with rotary drilling outfits for use in cat heading drill pipe in and out of wells. Patent 1568406. J. E. Le Bus, c/o J. E. Le Bus & Son, Electra, Texas.

GRAVITY REGISTER.—The primary moving element being a ball, adapted to be released and then perform certain registering operations. Patent 1568272. F. G. Diago, Box 1972, Habana, Cuba.

APPARATUS FOR SPUDDING, DRILLING AND CLEANING OUT WATER AND OIL WELLS.—The device being readily portable and capable of being carried by an automobile truck or similar vehicle. Patent 1568430. C. Uhl, 301 Chickasaw Ave., Bartlesville, Okla.

FILLING MACHINE.—Operated by pressure applied to the fluid or semi-fluid material to be filled, and will deliver a predetermined quantity. Patent 1569300. J. Purvis, Jr., 6405 So. Spaulding Ave., Chicago, Ill.

TRAVELING BRIDGE CRANE.—Which will quickly and safely pick up and set down a railroad car, or any other standard shaped object. Patent 1569269. F. W. Eagelston, 1416 Dodge St., Room 205, Omaha, Neb.

PLATEN RETURN.—Or relift, for use on machines of the type embodying a rotary printing drum and a roller platen, such as the multigraph. Patent 1569284. W. Kastler, 2808 Bartold Ave., Maplewood, Mo.

MACHINE FOR GRINDING GRAIN.—Which will grind or crush the grain for feed pur-

poses, and discharge the ground grain to any desirable place. Patent 1569561. G. E. Miller, Stratton, Neb.

COMBINED FINISHING MACHINE FOR PILE FABRICS.—Which may be readily adjusted to produce a pile raising operation to any desired extent during the process of finishing. Patent 1569785. M. Poetzsch, 91 Overbrook Road, Ridgewood, N. J.

VALVE.—Adapted to be attached to any cylinder steering gear, such as are used on stern wheel steamboats, for holding the rudder in position. Patent 1569417. G. T. Bollinger, c/o Barker Barge Line, Lockport, La.

FILM PRINTING MACHINE.—Which may be adjusted to accommodate any desired width or length of film strip, or may be used for printing from plates. Patent 1570498. J. Kalmanovitch, 4419 13th Ave., Brooklyn, N. Y.

ROAD GRADER.—So constructed as to entirely eliminate play between the cutting edge and the grader frame or circle. Patent 1570140. C. E. Gilbert, c/o The Gilbert Mfg. Co., Aberdeen, S. D.

FLOOR CLEANING AND POLISHING DEVICE.—In the form of a roller, adapted to be rotatably supported for movement in contact with the floor surface. Patent 1570127. E. J. Burch, 185 Adams St., Memphis, Tenn.

SHUTTLE ATTACHMENT.—Which tensions the thread as it is fed from the bobbin, controls movement, and severs the thread, if imperfect. Patent 1571114. T. J. Garisio, 637 N. 5th Ave., Allentown, Pa.

HOIST CONTROL UNIT.—Which is intended for use with hydraulic brake actuating mechanism, having means for operating the valves of the hydraulic system. Patent 1570753. H. H. Logan, c/o Duro-Metal Products Co., 2649-59 N. Kildare Ave., Chicago, Ill.

TEXTILE-FINISHING MACHINE.—For facilitating the operation of smoothing the fabric and imparting thereto a high luster or natural sheen. Patent 1571802. F. W. P. Rose and C. Werner, c/o Werner & Co., 183 Autumn Ave., Passaic, N. J.

COMPENSATING DEVICE FOR PUMPS.—Which may be readily connected to any size pump and to efficiently function to substantially maintain the discharge. Patent 1571,781. R. H. Aldrich, R. F. D. No. 2, Summit Lawn, Allentown, Pa

MACHINE FOR FORMING TUBULAR FABRICS.—For stitching together the edges of a strip of material, and pressing down and securing the same, in connection with a sewing machine. Patent 1571774. P. Gardner, c/o H. M. Bunker Co., 56 North St., New York, N. Y.

LIGHT CONTROL ATTACHMENT FOR FILM PRINTING MACHINES.—For printing motion picture films, in which the intensity of the light may remain constant or be varied by a light aperture. Patent 1572798. R. C. Hubbard and A. E. Mutscher, c/o Consolidated Films Corp., 729 7th Ave., New York, N. Y.

AUTOMOBILE HOIST.—Adapted for raising an automobile that a workman can work thereunder and avoid the necessity of a pit. Patent 1571178. J. P. Donovan, 137 8th Ave., San Francisco, Calif.

WRIST-PIN CONNECTION.—Which obviates the necessity of set screws, but will prevent longitudinal movement of the wrist pin with respect to the piston. Patent 1572795. D. Head, 1320 Birchwood Ave., Chicago, Ill.

COMBINED SAND PUMP AND DRILL.—By means of which no time is lost between the agitating of the sand at the well bottom, and the pumping. Patent 1572274. S. R. Evans and S. W. Collins, 314 W. Fairview, Tulsa, Okla.

AUTOMATIC FLOW CONTROLLER.—Which may function as a trap to discharge condensation from steam boilers, or as an overflow device for various purposes. Patent 1572784. D. A. Fleming, Pennsylvania State Normal School, Indiana, Pa.

CENTRIFUGAL SEPARATOR.—For separating solid matter suspended in a liquid in cases where the specific gravity between the elements is comparatively small. Patent 1572,299. F. W. McEntire, Hotel Utah, Salt Lake City, Utah.

Medical and Surgical Devices

NEUROVERTAMETER.—For the purpose of analysis and subsequent relocation of subluxated vertebrae in the human spine, as one of the operations in chiropractic. Patent 1571140. M. F. O'Connor, Sheridan, Wyoming.

HYPODERMIC SYRINGE.—Having a removable needle, which may be sterilized in a high temperature flame without injury to the needle. Patent 1569961. M. F. Bauchert, 803 1st Nat'l Bank Bldg., El Paso, Texas.

MASSAGE APPARATUS.—By means of which the patient may personally operate the same, for treating the spine to adjust or correct defects. Patent 1572794. C. L. Hamilton, 7907 5th Ave., N. E. Seattle, Wash.

OPTICAL DEVICE.—For training the eyes in unconscious shifting, and for proving to a patient the benefit from the practice of shifting. Patent 1572760. R. R. Arnau, c/o G. Ruiz, 16 Almarzo St., Madrid, Spain.

TROCAR.—An instrument characterized by the special form of cut it makes, used for the exclusive purpose of operating on food-bound animals. Patent 1573681. J. G. Direaux, Maipu 671, Buenos Aires, Argentina.

Musical Devices

MUSIC INSTRUCTOR FOR CHILDREN.—By means of which the relation of the position of notes and the keys of the piano are easily made. Patent 1558257. H. Fisher and D. Hoobler, c/o H. H. Fisher, Y. M. C. A., 1400 E. 53d St., Chicago, Ill.

MUSICAL INSTRUMENT.—Having novel means for readily changing the mechanism which actuates the key hammers, whereby any tune may be played. Patent 1565439. H. Haas, 519 E. Washington St., Marengo, Ill.

PEDAL PROTECTOR.—Which may be conveniently applied to the pedals of player pianos to preserve the same. Patent 1566,315. W. C. Daumueller, Lebanon, Ill.

Prime Movers and Their Accessories

MUFFLER.—Adapted to cause a cold stream of air to flow around exhaust gases, whereby the gases will be expelled in a steady stream. Patent 1572116. F. J. Herdle, 1847 W. Huron St., Chicago, Ill.

CARBURETOR.—In which a conical-shaped air controlled member is provided which gradually opens as the suction of the engine increases. Patent 1573689. P. A. Dumraese, 5 New Haven Ave., Milford, Conn.

AIR FILTER.—For filtering the air taken into the intake pipe of internal combustion motor carbureters to insure a cleaner mixture of combustible charge. Patent 1573656. R. E. Terhune, 861 E. 27th St., Paterson, N. J.

Railways and Their Accessories

SUPERHEATER CONSTRUCTION FOR LOCOMOTIVES.—Comprising a front superheater extending into the smoke box, and a rear superheater extending into the combustion chamber, connected by tubes. Patent 1563,683. F. A. Benolken, c/o Rev. J. H. O'Neill, Mount St. Charles College, Helena, Mont.

FEED-WATER HEATER FOR LOCOMOTIVES.—Having a tubular casing of annular form, the ends of the casing communicating with the steam chamber of a coupling. Patent 1567514. J. H. Kidwell, 422 Harle St., Staunton, Va.

SLEEPING-CAR LADDER.—For rendering the upper berth of a railway sleeping car conveniently accessible, and to prevent accidental falling of an occupant. Patent 1568,846. H. I. Jones and F. M. Pinkerton, 1538 Forest Ave., Wilmette, Ill.

STREET RAILWAY CONSTRUCTION.—In the form of paving blocks so designed as to be protected and reinforced at the points of greatest wear. Patent 1568677. W. F. McCanless, Kinney Bldg., Charlotte, N. C.

TRACK SANDER.—Having a special nozzle with a blast channel opening into the sand outlet for dislodging clogged or frozen sand at this point. Patent 1569830. J. H. Watters, Box 466, Anniston, Ala.

RAILROAD-CROSSING GATE.—On both sides of the tracks, the right-hand gate on each side being first closed to intercept traffic, the other gate closures following. Patent 1569,908. E. E. Beecher, c/o A. W. Beecher, 1039 Ocean Ave., Brooklyn, N. Y.

CAR DOOR.—Which is sliding and laterally movable, and includes means for making a storm proof contact when closed. Patent 1569834. B. Fuller, R. F. D. Box 24A, Newark, Calif.

JOURNAL BOX BEARING.—Of the roller type, which can be readily applied to a standard railway car journal box without altering the journal or box. Patent 1572121. H. Parker, c/o J. C. Parker, 1230 N. Dearborn St., Chicago, Ill.

Pertaining to Recreation

AMUSEMENT DEVICE.—In which cars are provided for seating passengers, to be operated to move over a convoluted annular platform. Patent 1564639. A. A. Stavick, Box 77, Sioux City, Iowa.

SKATE.—Comprising a foot plate, to be firmly secured to the foot, supported on two hooded wheels one in advance of the other. Patent 1566706. C. A. Thomas, Yakima, Wash.

GAME.—Which in its character is somewhat similar to baseball played in a restricted area. Patent 1568013. H. C. Warfield, P. O. Box 183, Merrick, L. I., N. Y.

GOLF CLUB HEAD.—More particularly golfing irons, the striking faces of which are characterized by straight grooves for materially enhancing the users playing ability. Patent 1569212. J. A. G. Aitken, Longwood Ave., Holyoke, Mass.

CHILD'S RIDING TOY.—Which in general appearance, and in its movements on a supporting surface closely resembles a miniature airplane. Patent 1569400. F. J. Schubert, 700 Demonbruen St., Nashville, Tenn.

FIGURE TOY.—In the form of a doll, operated by electro-magnetic means, which will cause the doll to operate a drum. Patent 1564674. H. C. Hodgkins, 7 Vley Road, Scotia, N. Y.

AMUSEMENT DEVICE.—Which will test the skill of the operator in manipulating a coin in its movements to answer questions in the nature of fortune telling. Patent 1564841. C. Fleischer, 52 Van Sinderson Ave., Brooklyn, N. Y.

TOY AMUSEMENT DEVICE.—Comprising a toy airplane which is adapted to be projected and to travel in the air at high velocity, a relatively great distance, with direction varied at will. The inventor has been granted two patents, 1565437 and 1565438. J. Greife, 201 York St., Newport, Ky.

GOLF BAG.—Known as caddy bags, in which the golfing sticks cannot be thrown against one another, being held separate, yet easily removable. Patent 1570500. B. Kennedy, c/o Ken-Wel Sporting Goods Co., Gloversville, N. Y.

TOY VEHICLE.—Adapted to be straddled by a child and to be propelled by body movement of the rider. Patent 1570849. R. H. Manley, Cottonwood, Arizona.

DOLL.—Which when caused to simulate a dance will issue sounds as if the doll were whistling. Patent 1571868. G. H. Parsons, c/o Averill Mfg. Co., Wales Ave. and 143rd St., New York, N. Y.

EXERCISER.—Permitting a person not having access to a gymnasium to have the benefits of a rowing machine at home. Patent 1572802. C. D. Layman, 641 S. 34th St., Louisville, Ky.

GAME.—Including a target member, and members in the nature of catapults for effecting the movement of projectiles toward the target. Patent 1573711. L. C. Houle, Box 72, West Pittsburg, Pa.

Pertaining to Vehicles

STOP AND DIRECTION INDICATOR.—Which constitutes an illuminated device that may be strapped to the arm of the driver for night signaling. Patent 1568361. E. L. Blanchfield, 981 Oliver St., San Pedro, Calif.

PASSENGER COMPARTMENT.—For public conveyances, by means of which all possible space, ordinarily wasted, may be utilized by the use of tiers of seats. Patent 1568855. A. W. Lawson, 1819 Broadway, New York, N. Y.

DIRIGIBLE HEADLIGHT FOR VEHICLES.—In which the working mechanism is entirely housed and protected from dust or foreign matter. Patent 1569261. J. M. Calkins, Box 611, Detroit, Mich.

IMPLEMENT ATTACHMENT FOR TRACTORS.—Which permits the placing of the implement in front of the tractor, without altering the construction of the tractor. Patent 1569011. C. E. Gilbert, c/o Gilbert Mfg. Co., Aberdeen, S. D.

PRESSURE INDICATOR.—Permanently carried by the wheel, so that at a glance the exact air pressure may be ascertained, without soiling the hands. Patent 1565423. G. Dailey, Bison, So. Dak.

HEADLIGHT.—Which is adjustable and controllable, and will properly illuminate the road without subjecting drivers of oncoming vehicles to blinding glares. Patent 1569282. E. E. Hughes, c/o J. S. Egbert, Box 79, Wallace, Idaho.

OPERATING MECHANISM FOR DIRIGIBLE HEADLIGHTS.—Which imparts in a smooth and easy manner the proper movement to the headlights when the vehicle is steered. Patent 1566074. G. Cook, Box 53, Gillett, Wis.

SIGNALING DEVICE.—Comprising an arm extending in horizontal direction to indicate the stopping or turning of a vehicle, visible by day or night. Patent 1563790. J. M. Reid, 501 Grant St., Pullman, Wash.

TRACTOR.—For garden or farm implements, adjustable for securing high speed with comparatively small power, or slow speed with comparatively great power. Patent 1566230. G. H. Scanlan, c/o J. A. Sheehan, 44 Court St., Brooklyn, N. Y.

DIRIGIBLE HEADLIGHT FOR VEHICLE.—Adapted to turn automatically when the steering wheel is turned, and to throw the light just in front of the car. Patent 1567,112. J. M. Calkins, Box 611, Detroit, Mich.

TRACTOR HITCH.—Which will permit relative separation of the drawing and drawn vehicles under conditions such as when a mud hole is encountered. Patent 1566740. C. T. Forrest, Le Grand, Calif.

MOTOR VEHICLE.—Having means for steering and driving a plurality of vehicle axles directly, so that each axle is steered by the preceding one. Patent 1566726. D. H. Bradley, Apartado 56, Parral Chih, Mexico.

BRAKE MECHANISM FOR AUTOMOBILES.—Which provides operating means between the ordinary foot brake pedal and the emergency lever and the four wheels of the car. Patent 1567982. I. F. Pfeifer, 429 Central Trust Bldg., Altoona, Pa.

AXLE BRACE AND POSITIONER.—Designed to engage the front axle and radius rods of a "Ford" car, and hold the axle in proper position. Patent 1569905. J. A. Mebane, South Boston, Va.

HEADLIGHT.—In which the lighting unit is adjustable within the casing, so that the proper focusing of the light will eliminate glare. Patent 1570491. W. A. Irwin and E. S. Schwartz, c/o E. S. Schwartz, 507 5th Ave., New York, N. Y.

ANTISKID ATTACHMENT FOR AUTOMOBILE WHEELS.—Which prevents the wheel from skidding, also provides an increase in the contacting portions of the wheel. Patent 1570359. H. B. Lindhorst, Route No. 3, Box 188, Springfield, Missouri.

DIRECTION SIGNAL.—Adapted to be manually moved to any one of several positions, to indicate the intentions of a motor vehicle driver. Patent 1570158. N. W. Knight, E. 1819 Ninth Ave., Spokane, Wash.

LENS.—Adapted for use in connection with headlights of motor vehicles for diffusing the light and eliminating glare. Patent 1569973. F. K. Goettert, 123 Ellisworth Ave., San Mateo, Calif.

LINING FOR TRANSMISSION AND BRAKE BANDS.—Constructed from woven or textile fabric, for preventing the glazing of the face, and lengthening the life of the lining. Patent 1571085. C. Brahs, McBride Ave., Paterson, N. J.

ATTACHMENT FOR SUPPLY TANKS OF AUTOMOBILES.—Which will indicate to a driver the necessity of refilling the tank. Patent 1571111. J. W. Farrior, Warsaw, N. C.

SPEED CHANGING TRANSMISSION.—By means of which it is possible to obtain either low or high speed of a driven shaft, in a gradual manner. Patent 1570867. F. H. Tanner, 37 Downend Road, Bristol, England.

TOWROPE.—Which may be conveniently applied to a car, and quickly shortened or lengthened as required. Patent 1572771. C. A. Connelly, Shelby, Ohio.

Designs

DESIGN FOR A DRESS-TRIMMING ORNAMENT.—Patent 69289. Maude Siegel, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A DOLL.—Patent 69252. J. Chapman, 159 W. 85th St., New York, N. Y.

DESIGN FOR A WOVEN FABRIC.—Patent 69250. L. Bluhm, c/o Phoenix Mfg. Co., 40 Thomas St., New York, N. Y.

DESIGN FOR A FERRIS WHEEL TOY.—Patent 69335. E. H. Tunley, c/o Pickwick Mfg. Co., 129 Patchen Ave., Brooklyn, N. Y.

The Book Department

On the theory that best sellers are best books, we have assembled those publications from our Book Column that have proved our best sellers and present them to you in one listing. Some of these may have previously escaped your attention.

The New Theories of Matter and the Atom by Berthoud.....$3.65
A summary of the latest developments in the scientific theory, approached by an historical consideration, making them intelligible with a moderate knowledge of science.

Blue Print Reading and Shop Sketching by Givens..... 1.90
Typical drawings are explained in detail, with advancing degree of simplicity. Shop sketches are shown with cross-section paper below for home study and the use of various measuring instruments illustrated; projection explained; drafting precisely depicted.

Surveying For Everyone by Williams..... 1.55
The layman who wants to know something about surveying will here find simple methods graphically illustrated, that can be worked by anyone.

Atoms and Rays by Lodge..... 3.15
A theoretical treatment of the subject by Great Britain's most prominent Physicist. A masterly contribution to science.

The Electron by Millikan..... 2.15
(Its isolation and measurement and the determination of some of its properties.) Millikan is to the United States what Lodge is to Great Britain. This book fully justifies his position as one of the leading Atomic theorists.

Constitution of Matter by Born..... 2.65
Translated from the German. Three valuable essays which deal with their subjects from different points of view. They have been carefully brought up to date, incorporating the latest advances.

The A B C of Atoms by Russell..... 2.15
A thoroughly admirable book for the reader, who, while not familiar with technical physics, wishes nevertheless to be informed of its latest developments.

Ether and Reality by Lodge..... 2.15
A series of discourses on the many functions of the ether of space, written for the layman.

How Radio Receivers Work by Van B. Roberts..... 1.15
A complete well illustrated treatment of the many phases of radio reception, being specially valuable to constructors. Many significant points omitted in other works are fully covered.

Curiosities of the Sky by Serviss..... 3.15
In the sky the layman has seen curious bodies, constellations, stars, comets, meteors, lights and has often asked himself what it is all about. This book tells him, and puts him on the road to a more intimate knowledge of that fascinating science, Astronomy.

Beginner's Star-Book by McKready..... 5.15
Those who are without technical equipment will appreciate the Author's effort to assist them in claiming through the unaided eyes, or through simple optical instruments, their heritage in the things of the sky.

Modern Astrophysics by Dingle..... 8.65
A book which has long been needed. Thoroughly covers the newer developments of astronomy based on the great advances of the 20th century. As non-technical as it is possible to make this somewhat advanced subject, and especially valuable to those who regularly follow Professor Russell's monthly articles in the Scientific American.

A Text-Book of Physics by Spinney..... 3.95
A complete reference especially strong on Electricity and Magnetism along the lines of recent development. The Third Edition.

Clockmaking by Gordon..... 5.20
The author covers ground which either has not been trodden before or expands details which experience indicates should be amplified. It presupposes acquaintance with Britten's books on fundamentals.

Sermons of a Chemist by Slosson..... 2.20
By profession a chemist, by conviction, of confirmed religious beliefs, the author splendidly strengthens the tie between religion and science.

Drafting Methods by Trowbridge..... 2.65
Suggestions for simplifying and easing draftsman's labors, have been collected by the author for many years and are here given with much detail.

Graphic Table-Logarithms and Anti-Logarithms by Lacroix-Ragot..... 1.55
Gives directly without interpolation, logarithms to five places, of all five-place numbers, and conversely, with graphic table reading to four places. A revolutionary aid to calculations.

Practical Mathematics by Hobbs-Waite-Schroeter..... 1.65
The essentials of the various processes, with special emphasis on the practical side of the subject. Covers logarithms, practical geometry and curve plotting.

All prices postpaid

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

CONTENTS
MAY 1926

ARTICLES

Ancient Mariners and the Spread of Early Civilization—By Prof. G. Elliot Smith..... 293-294
How Can We Produce Scientific Workers?—By Prof. T. D. A. Cockerell..... 296
Malaria and the Mosquito Fish—By Dr. David Starr Jordan..... 296-297
Acoustical Research in Auditoriums—By H. H. Sheldon, Ph.D..... 298-299
Our Point of View—Editorial..... 300
Is Anti-aircraft Artillery Overtaking the Airplane?—By Colonel H. E. Cloke..... 301-303
The Great Outer Planets—By Henry Norris Russell, Ph.D..... 304
Tut-Ankh-Amen's Golden Coffins—A page of photographs..... 305
Radio Whirlpools in the Ether—By Orrin E. Dunlap, Jr..... 306-307
Old Problems and New Methods in Prehistory—By Prof. George Grant MacCurdy..... 308-309
The New Cosmology—By Prof. William Duncan MacMillan..... 310-311
A Diamond Quest in California—By Winfield Scott..... 312-313
Interesting Air Stamps and Historic Cancellations..... 314
Horsepower from the Tides—By J. Bernard Walker..... 315
Another Way to Conserve Our Valuable Forests—By R. K. Heiphenstine, Jr..... 316-317
Western City Ends Flood Menace—By J. E. Murphy..... 318-319
An Underground Moving Picture Theatre—By James H. Collins..... 320
Fossils in Architecture—A page of photographs..... 321
Nature Faking—By S. F. Aaron..... 322-323
From the Scrap-book of Science—Two pages of photographs..... 324-325

DEPARTMENTS

Novel Devices for the Shop and the Home..... 326-328
Scientific American Digest..... 329-337
Science and Money—Bonds—A Technical Consideration..... 338-340
The Heavens in May..... 340
In the Editor's Mail—Where Reader Meets Reader..... 341-344
Radio Notes..... 345-350
Learning to Use Our Wings—A Department of Aviation News..... 351-356
Commercial Property News..... 357
Patents Recently Issued..... 357-359

INDEX TO ADVERTISERS

Absorbine, Jr. 340
Adair Realty & Trust Co..... 338
American Blower Co..... 344
American Lead Pencil Co..... 336
American Patent Protection Corp..... 338
American Pipe Bending Machine Co..... 336
American Sheet & Tin Plate Co..... 343
American Telephone & Telegraph Co..... 336
Anderson-Pitt Corporation 352
Arguto Oilless Bearing Co..... 347

Francis Bannerman Sons..... 350
W. F. & John Barnes Company..... 334
Benton Harbor Malleable Foundry Co..... 342
Bernard & Heller..... 352
Box 168 342
Bradley Polytechnic Institute..... 346
Broderick & Bascom Rope Co..... 340
E. J. Bunker..... 336

Chicago Stock Gear Works..... 350
Cortez Cigar Co..... 350

Dayton Steel Foundry Co..... 349
F. J. Drake & Company..... 346

Firestone Tire & Rubber Co..... 342
Florsheim Shoe Co..... 353

General Electric Co.....Fourth Cover
Geneva Optical Co..... 349
Golden Book Magazine..... 354
Golf Ball Die Co..... 346
J. L. Greenwood..... 352

Harper & Brothers..... 340
Hotel Fort Shelby..... 352
Hotel Marseilles 350
Huther Bros. Saw Mfg. Co..... 342

International Harvester Co. of America, Inc. .....Second Cover
International Typewriter Exchange..... 350

Laboratory Materials Co..... 350
Lambert Pharmacal Co..... 335

Languages Publishing Co..... 346
Lefax, Incorporated 352
Liggett & Myers Tobacco Co..... 346

Metal Cast Products Co..... 342
Metallic Sign Letter Co..... 350
W. & D. Mogey..... 350
Moore & Company..... 346
R. L. Morrow..... 336
Munn & Company.....348-352

National Carbon Co..... 345
New Era Manufacturing Co..... 346
Norton Company 337

Packard Motor Car Co..... 290
H. K. Porter, Inc..... 334

Razor Products Corporation..... 349

Schwerdtle Stamp Co..... 346
Sheet Steel Trade Extension Committee..... 333
Simonds Saw & Steel Co..... 351
James Sinclair 350
Skayef Industries 288
South Bend Lathe Works..... 336
Stephenson Laboratory 350
Stewart Iron Works Co..... 352
Success Magazine Corporation..... 356

Timken Roller Bearing Co.....Third Cover

Unisol Manufacturing Co..... 334
Universal Motor Co..... 346

Veeder Manufacturing Co..... 353
Vilter Manufacturing Co..... 342

Weyerhaeuser Forest Products Co..... 339
Willamette Iron & Steel Co..... 292
Wisconsin Electric Co..... 351
Wisconsin Motor Mfg. Co..... 341
Wright Manufacturing Co..... 350

Carl Zeiss, Inc..... 350
Henry Zuhr, Inc..... 350

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

ORSON D. MUNN, President — ALLAN C. HOFFMAN, Secretary and Treasurer

EDITORIAL STAFF

O. D. MUNN, Editor and Publisher — J. BERNARD WALKER, Editor Emeritus
ALBERT A. HOPKINS — ALBERT G. INGALLS — KATRINE A. CAMPBELL
MILTON WRIGHT — LOUIS S. TREADWELL
PROF. HENRY NORRIS RUSSELL — PROF. ALEXANDER KLEMIN
CHRISTINE M. LEWIS, Editorial Assistant

CORRESPONDING EDITORS

H. DIEDERICHS, Prof. of Experimental Engineering, Cornell University.
SAUL DUSHMAN, Ph.D., G. E. Research Laboratory.
EDWARD ELLERY, Consulting Chemist, Union College.
RALPH J. FOGG, Prof. of Civil Engineering, Lehigh University.
LEON A. HAUSMAN, Ph.D., Asst. Prof. of Zoölogy, Rutgers College and State Univ. of N. J.
HARRY S. HOWER, Prof. of Physics, Carnegie Institute of Technology.
AUSTIN C. LESCARBOURA, A. I. E. E., Croton, New York.
M. LUCKIESCH, Dir., Lighting Research Laboratory, National Lamp Works of General Electric Co., Nela Park, Cleveland.
D. T. MACDOUGAL, Director, Laboratory for Plant Physiology, Carnegie Institution of Washington.
ROY W. MINER, American Museum of Natural History.
H. F. MOORE, Research Prof. of Eng. Materials, University of Illinois.
DR. WALTER FRANKLIN PRINCE.
H. C. RAMSOWER, Director of Agricul. Ext. Service, Ohio State University.
SAMUEL J. RECORD, Prof. of Forest Products, Yale University.
J. HAMMOND SMITH, Prof. of Civil Engineering, Univ. of Pittsburgh.
G. A. YOUNG, Head, Mechanical Engineering, Purdue University.

Western Advertising Office, Wilson and Galey, Harris Trust Building, Chicago, Ill.

Vol. 134, No. 5. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

"Cool" Millions of Bearings

Down in the cooling pits Timken steel lays over, en route from Timken electric furnaces to the innards of your automobile or motor truck. Every step of the way is entirely within the marvelously self-contained Timken works, until the finished bearings are shipped to 83% of all the motor vehicle factories in America.

Into transmissions, differentials, pinions, worm gears, rear wheels, front wheels, steering pivots, and fans the Timken Bearings go. They are so nearly universal in cars and trucks—among the many types of Timken-equipped machinery—that 132,000 bearings daily are added to the 150,000,000 Timkens already applied.

Each part which turns on Timken Bearings saves fuel and power, since there is no excess friction. Timken-mounted units have a better chance to stay "like new" because Timken Taper and Timken positive roll alignment mean higher resistance to shock, sway, lurch, and speed. And Timken-made electric steel assures you of finest material where it is most needed.

Here are the elements of longer life, smoother operation, simplified care, and consequent all-around economy. See that you buy Timken-equipped.

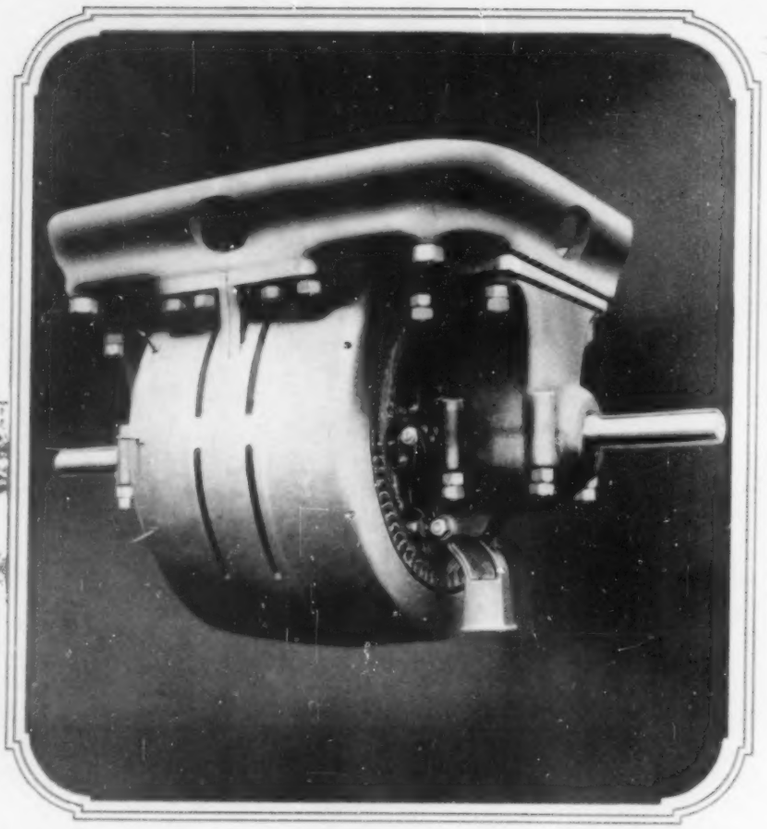
THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

Timken output of electric furnace steel is the largest in the world. At the stage illustrated the steel is in "billet" form. It cools off in pits lined with fire brick.

TIMKEN *Tapered Roller* BEARINGS

Printed in the United States, by ANDREW H. KELLOGG CO.

Tall smokestacks are rapidly disappearing, for electricity has been a great factor in building up the new South which now has more than 17,000,000 spindles—most of them electrically driven.

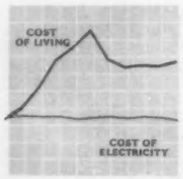


How long will a G-E motor last?

Alter 44 years, three Edison dynamos are still lighting a textile mill at New Bedford, Mass. Another record is held by a G-E generator which has run 24 hours a day since 1900 with only six shut-downs. At Tonawanda, N. Y., 16 G-E motors have worked steadily since 1895. General Electric Company records contain many similar instances. What work have you to do? Running a sewing machine or driving a battleship? There is a G-E motor that will do it faithfully for many long years.

NOBODY KNOWS. But at Columbia Mills, South Carolina, the first electric motors ever installed in a textile mill are still serviceable after 30 years of hard work. Their rated capacity was only 65 horse-power but that was four times as large as any motors the General Electric Company had then built.

For ten years some of these motors ran day and night; most of the time they were called upon to deliver 85 horse-power instead of their rated 65 horse-power. Yet such stamina was built into them that every one of these veterans is today quite capable of a full day's work, and fourteen of them are actually in active service.



It is interesting to think how many million yards of good cloth these faithful servants have helped to produce and how much they have saved consumers by doing their work at so low a cost.

GENERAL ELECTRIC